INFANT EDUCATION

ERIC PRITCHARD

Margaret Jeffries.

General Hospital,

Nottingham.

September 1930.

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By

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WITH A PREFACE

BY

ALEX. WYNTER BLYTH, M.R.C.S.

LATE MEDICAL OFFICER OF HEALTH FOR THE BOROUGH OF ST. MARYLEBONE

SECOND EDITION. *REVISED AND ENLARGED.*

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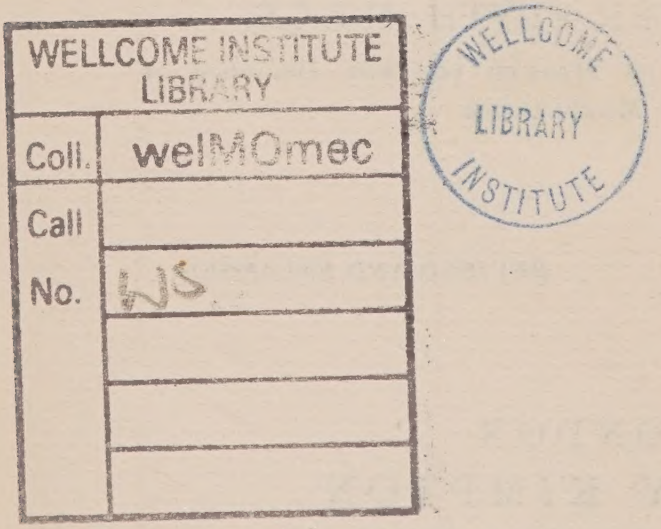

AUTHOR'S PREFACE TO SECOND EDITION

It is now nearly fifteen years since the first edition of this little volume was published, and since then many changes and developments have occurred in the Welfare Movement. The example of Marylebone has been followed all over the country, and there are now nearly 1,600 Welfare Centres in England and Wales. The infant mortality rate not only in Marylebone but also throughout the country has fallen very nearly 33 per cent., and this improvement is undoubtedly and mainly due to improved methods of mothercraft. There still, however, remains room for improvement and much spade work must be done.

In revising this little volume, I have added four chapters which I hope will prove useful: one on the care of the new born infant; one on the feeding of children, at and after weaning; one on the practical details of infant feeding, and one on Rickets. I have omitted from this edition certain notes with respect to case papers and leaflets of instruction for mothers which were published in the Appendix of the first edition, as information on these matters can now be obtained elsewhere.

E. P.

Harley Street, W.

PREFACE TO FIRST EDITION

By Alex. Wynter Blyth, M.R.C.S.,
Late Medical Officer of Health of
St. Marylebone.

The recent annual report of the Registrar-General shows that the birth-rate for England and Wales has decreased during the past 35 years by 21 per cent., or, if the rate be calculated on the proportion of the total number of births to the total number of women living at child-bearing ages, the decrease is as much as 27.3 per cent. Over-production lessens, under-production enhances the value of commodities. Considering the life of an infant as a commodity its money value must be greater than 35 years ago. It is of concern to the nation that a sufficient number of children should be annually produced to more than make good the losses by death; hence the importance of preserving infant life is even greater now than it was before the decline of the birth-rate. It is not, however, enough, from an hygienic point of view, to preserve infantile life; this might be accomplished by means giving as a result an army of sickly weaklings likely to add in the future to

the burdens of the community ; the infants must not only live their lives but must be healthy and vigorous ; their internal organs, muscular systems and senses must be trained to resist ordinary influences detrimental to health—they must acquire the power themselves of helping themselves. Dr. Pritchard in the following pages teaches this lesson in simple forcible language, the lesson of automatic self-help.

He does not believe in a hand-fed infant being nourished with food already digested. Give the stomach something to do. Throw into the dust-bin more than half the soluble, sugary, peptonised, artificial foods.

How do you expect to develop a healthy stomach, capable of tackling cheese and pickled cabbage, unless it has an opportunity of exercising its proper functions from the earliest years? The stomach is an organ provided for the express purpose of digesting ; it is not a bag for the reception of pabulum digested outside in a test tube.

The skin of the infant and its heat-regulating mechanism has to be gradually accustomed to considerable and sudden changes of temperature ; this cannot be effected by eternally wrapping it in layers of cotton wool, and keeping it in a stuffy room at an incubation tempera-

ture. However warm an infant has to be maintained for a short time after birth, Dr. Pritchard shows that, as time goes on, prudent exposure to abundance of fresh air is in no way injurious.

The readers of this work — who, it may be hoped, will be numerous—cannot fail to be struck with the ingenious suggestions offered in it for the education of the automatic and rhythmic movements of the intestine, of the bladder, as well as of various internal secretions.

It is a happy thing for the St. Marylebone Health Society that so practical a work as these lectures should be its first original publication. The great thing needed is that the principles here inculcated should reach those whom it most concerns ; total abstainers discourse in the main to the temperate ; churches are filled with the devotional ; those who most need direction or instruction too often get least. We must rely on our working staff to convey, in an unconventional manner, many a useful hint, many a taking phrase culled from this work, into home and crêche. If healthy infants are to be reared, our labours must not be strictly confined to unlovely streets and squalid poverty-stricken dwellings. It would appear that young mothers in every station of life are for the most part really ignorant of the best way to nurse their

own children; the so-called maternal instinct teaches little of value as to the rearing of infants. Maternal instinct has been known to dose an infant at the breast with drops of stout and teaspoonfuls of gin. Maternal instinct stills a child with soothing syrup when it cries, and overlays it when it sleeps. Maternal instinct is erratic, irregular, and altogether untrustworthy.

The advice given in these lectures is based on the solid record of experience. "Science is measurement" is the motto of Mr. Stacey Mark's well-known diploma picture. The effect of the practical application of the principles inculcated has been mathematically tested by measurements, by weighings, and by other exact methods of observation at regular intervals of time for prolonged periods, and thus proof is furnished, if proof is needed, of the general soundness of the views herein advanced.

A. Wynter Blyth.

3, Upper Gloucester Place, W.
September, 1906.

INTRODUCTION.

In case this little volume of lectures should fall into the hands of readers who are unacquainted with the aims and objects of the Borough of St. Marylebone Health Society it may not be out of place in this introduction to give a short account of the history of the Society, and to outline in brief its proposed line of policy in future operations.

The Society was formally inaugurated at a meeting held at the Public Health Department of the Borough of St. Marylebone in February, 1906, and at this meeting a General as well as an Executive Committee was elected. It was decided, as far as possible, to constitute the Society on lines similar to those of the City of Westminster Health Society, to adopt its general methods, and for the present to concentrate the energies of the Society on two specific objects; firstly, on the prevention of the spread of tuberculosis, and, secondly, on the reduction of infant mortality among the poor residing within the area of the Society's operations. With the first part of the campaign, I am not concerned in these pages; it is to be hoped,

however, that the tuberculosis problem will be fully dealt with in a separate number of the Society's lecture series, a series which, we trust, will increase in size and importance, as the Society attacks other questions which affect the health of the community residing within the sphere of its activity.

As far, then, as the question of infant mortality is concerned, our Society has determined to institute an active campaign for the purpose of educating and instructing the mothers, and to supervise the rearing and general management of infants born within the Borough of St. Marylebone. For the fulfilment of this somewhat ambitious project a vast amount of organisation has been found necessary, for the Society has very wisely recognised the desirability of not interfering with existing philanthropic schemes, but rather to centralise and utilise all available machinery that already exists for dealing with this very question.

In order to educate the mothers, and supervise the management of their babies, it was considered necessary in the first place to organise a large staff of competent visitors. To accomplish this end two Wardens were appointed, one for the Northern and one for the Southern section of the district, and to these Wardens powers

were entrusted to organise out of the available material a staff of visitors to undertake the necessary duties. It is impossible to praise too highly the manner in which this difficult task has been accomplished by our two Wardens, namely, Miss Broadbent and Mrs. Dobell, who have, respectively, charge of the Southern and Northern sections.

Although a considerable number of the newly-appointed staff were already experienced in the kind of work that was required of them, the Society fully recognised that it was desirable that there should be uniformity and continuity in the methods employed by the individual members of the Staff in dealing with the objects in view, and for this reason it was proposed that a course of lectures should be given to the visitors on the subject of infant management, and that these lectures should be published for the benefit of those who could not personally attend, or who might be appointed subsequently to the delivery of the lectures, and that they should constitute a sort of guide or work of reference for the help of such visitors. The lectures, then, which appear in this volume form part of the general scheme ; they were delivered before the staff of the Society's visitors at the St. Marylebone General Dispensary, and they

represent for the most part an amplification of the original leaflet on "Advice to Mothers" which was drawn up by the Society.

Recognising that the whole success of the scheme rested on the efficiency and experience of the individual visitors, our two Wardens accepted an offer made by the Board of Directors of the St. Marylebone General Dispensary, that visitors of the Society should attend at the "Infant Consultations" which are held every afternoon during the week, and act in the capacity of "clinical assistants" to the attending physicians.

The system of "Infant Consultations" which has recently been instituted at the Dispensary is founded somewhat on the lines of the "Consultations de Nourrisons" introduced by Professor Budin at the Charité Hospital in Paris. To these Consultations any infant provided with the necessary "letter" can be brought, and kept under medical supervision during the first two years of life.

The mothers are advised as to the general management of their babies, and on matters affecting their own health, and every effort is made to encourage breast feeding, and in those cases in which this is impossible they are instructed how to adopt the best and most careful

methods of bottle feeding. Each time the infants are brought to the Dispensary they are stripped, weighed, and thoroughly examined, and complete notes are taken as to their general progress and condition, and recorded on printed forms which are kept for this purpose. At the end of each year prizes are offered to those mothers who, in the opinion of the attending physicians, have most satisfactorily complied with the instructions given, and have been most regular in their attendances.

The inducements thus offered to careful and painstaking management on the part of the mothers, and the object lesson afforded by the consultations themselves, will, it is hoped, constitute an important and useful part of the general scheme of the Society in dealing with the question of infant mortality.

Moreover, the opportunity thus afforded for training new members to fill vacancies in the staff of visitors, is an advantage which all those who are interested in the work of the Society very fully appreciate.

And now let me say a few words on the subject of the lectures themselves. In the first place, I must take on my own shoulders all responsibility for the various views and opinions expressed in them. If on occasions I may

appear to have been more dogmatic than circumstances warrant, I must beg indulgence on the ground that there must be no uncertain ring about a lecture which is for teaching purposes, and if at times I have been discursive and wandered far afield, my apology is that I have attempted, probably with the greatest unsuccess, to make my lectures on the threadbare subject of infant management of interest. The reason for the title which I have chosen for my lectures will be manifest to all those who have patience to read the following pages. I take this opportunity of recording my grateful thanks to Dr. E. B. Hulbert for the many services he has rendered me, both at the time of the delivery of these lectures, and during the reading of the proof sheets.

E. P.

35, Harley Street, W. 1.

September, 1906.

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The Physiological Feeding of Infants.

A Handbook of the Principles and Practice of Infant Feeding. Fourth Edition. Greatly enlarged and entirely Rewritten. Illustrated.

[*In Preparation.*

The Physiological Nursery Chart and Nursery Emergency Chart.

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Infants' Food Table.

CHAPTER I.

ANTENATAL HYGIENE, OR THE MOTHER'S DUTIES TO THE UNBORN CHILD.

I THINK if you were to ask a number of prospective mothers, not only of the class with which our Health Society has to deal, but of any class, to define what they considered to be their prematernal duties, that the majority of them would answer somewhat in this wise: "I must engage a doctor and a nurse; I must purchase a layette, a bassinet, a basket, a binder, a baby's bath, and provide all the other paraphernalia necessary for the expected event." Far be it from me to suggest that any one of these items is superfluous or unnecessary; indeed, I would greatly supplement this list by suggesting that the antiseptic preparation of the room in which the confinement is to take place, and of the person of the woman herself, are equally necessary duties. But in this lecture, although possibly I may have time to say a few words on these matters, I propose to take a very much wider view of the duties of the prospective mother, and to approach them from a point

of view which is of vastly more importance to the future welfare of the infant and of the race.

In a later lecture I shall insist on the importance of a correct dietary for the new born infant, premising that the future stability of the human edifice is dependent on the manner in which these early foundations are laid. This analogy between the foundation of a building and the early growth of the human infant, though sufficiently accurate for the purpose, will not bear critical examination, for no man would venture to assign even a proximate date to the first foundations of the human race and much less to that of any particular individual. The stages in the building up of the human edifice can be traced from babyhood through fœtal life within the mother's womb, thence backwards again to the paternal and maternal germinal cells which when fused together are endowed with a marvellous capacity for reproducing a combined image of the two parents. If we trace the still more remote history of the two germinal halves of which the impregnated ovum is composed, we find that before conception the ovum (or the germinal cell of the mother) and the spermatozoon (or germinal cell of the father) have resided in the respective generative organs of

the two parents, sharing with them their vicissitudes of health and ill-health. These germinal cells might more justly be considered the foundation stones of the future complete individual than the cells which are produced by the individual growth of the infant after birth. It must, however, be carefully remembered that even the germinal cells in the two parents do not represent the commencement of life, for they can be traced back in unbroken continuity in the germinal cells of their parents and grandparents before them, and through a long succession of remote and more remote ancestry; indeed, through all the ramifications of our genealogical tree. You and I, then, have been in process of making ever since organic life first appeared upon the earth; there has never been a break or an interruption in the continuous chain of generations for the hundred million years or more which represent the span of our ancestral history. The actual foundation stones of our completed edifice were laid, then, at a period so remote that we possess but a very incomplete account of their history, but this we know — our form, our shape and structure, our functions and our general physical condition represent the total or summated effects of the building opera-

tions which have been going on ever since the first foundation stones were laid these countless centuries ago. We know that every succeeding generation in our long ancestral line has added or subtracted something, be it for good or evil, for present or prospective advantage, for present or prospective disadvantage; but what is the influence of one generation, one brick, in foundations that date back a hundred million years? Is it not a mere drop in the ocean? Racial or family characteristics can only become pronounced or permanent when any particular race or any particular family is exposed generation after generation to exactly the same conditions of life, of climate, of food, and of habits. Suppose, for instance, that by accidental or fortuitous circumstances one particular family were to become the possessor of great wealth or broad acres, and that these possessions were to be handed down in an unbroken sequence through many generations, and suppose that all the beneficiaries, for the time being, of the worldly advantages which such possessions carry in their train were to make bad use of these opportunities and live vicious, irregular, self-indulgent lives, what would be the survival prospects, in the struggle for existence, of the future representatives of

this particular family? They would be, as you know, extremely bad. Each generation, as it were, adds one brick to the foundations; that brick according to the manner of life of the individual mason may be of sound material, truly, strongly laid, or the material may be bad, and the workmanship unsound. It is when many successive bricks or rows of bricks are laid in any one particular way that any permanent or far-reaching impression is made on the general stability of the foundations of any family or race. The force of heredity in the human race is immeasurably great; it proceeds from generation to generation with the crushing, inexorable momentum of centuries behind it. It would be as difficult to deflect it from its predetermined path as to deflect from its course upon the ocean a modern battleship, or the world itself rotating on its eternal axis. Nevertheless, each little shock may have its puny effect, and if each shock were applied in exactly the same direction and repeated sufficiently often, not only might the battleship be ultimately deflected from its course, but the axis of rotation of our world might be transmuted, and even the inertia of heredity overcome. Thus may new family characteristics be induced, and old ones eliminated.

I hope I am not conducting you too deeply into the mazes of philosophy and the problems of heredity by thus introducing you to some of the most debated principles of biology, but a knowledge of the hereditary transmission of disease from one generation to another, and of the handing on from father to son of the consequences of corrupt and vicious living, must be inseparably bound up with the furtherance of the aims and objects of a Society such as ours, which is fighting not only for improvement in the present physical condition, but for the future prosperity of a not unimportant section of the community. This being so, I feel that, if it lies within my power to make you understand some of the biological reasons why vicious, self-indulgent or irregular living on the part of the parent may be visited on the children, I am justified in calling your attention to this important matter.

Let me try, then, to explain to you in as simple language as I can command, some of the forces that can be brought to bear on the making of strong and healthy men. I shall refer later to some of the most important principles involved in the scientific feeding of infants, and I shall explain how you can only build up a strong and healthy individual out of

good material; in other words, out of food which is adjusted to the requirements and growth of the developing infant, and I shall insist most strongly on the necessity for adequate nitrogenous feeding. I shall explain, too, why it is, that the correct feeding of infants is so much more important than the correct feeding of older children or grown up individuals, and that this is so because during infancy you are adding to the foundations on which the permanence and durability of the whole superstructure depended. I now want to remind you that, even before infancy, a very considerable part, and a very important part, of the foundations have been already prepared, partly during the development or growth of the embryo in its mother's womb, and partly, even before that time, in the generative organs of the two parents, and of the grandparents, and in those of all their ancestors before them. How these early foundations are laid depends on the manner of living of the individual parents, of the grandparents, and of each individual ancestor in the whole chain of remote ancestry, but most important of all, from the point of view of the immediately succeeding generation, is the manner of living of the mother. In families who have lived self-indulgent, luxurious and vicious

lives, these foundations, brick by brick, stone by stone, have been laid of bad material with bad workmanship, insecurely cemented together, and thus it is now, as it has been ever since the world began, that too much prosperity and excess of riches often compass the end of these families on whom the contemporary success of a nation most depends. Why is it that so often the men who have most to leave, and most desire an heir, have no opportunity of being represented among future generations? It is because brick by brick, stone by stone, the consecutive steps in the laying of the foundations have been carried on under circumstances utterly opposed to good workmanship. Do not let it be supposed for one moment that it is only the rich and successful who prove bad masons, and set awry the foundations of the coming race. The poor, the starved, the debilitated and the oppressed are no less offenders, albeit helpless and unwilling offenders in this respect, but remember this, no indiscretion or breach of the laws of hygiene which operates adversely on our own health can be committed with impunity to the health of those germs within us on which depend the perpetuation and survival of our future representatives.

Some of us who ponder on these questions

and presume to question why, may well ask what right have our parents to jeopardise our health and happiness by selfish indulgence, and by the contravention of the laws of hygiene? In its ultimate effects it would have been a far greater sin against you or me if your mother or my mother had indulged in alcoholic excesses or drug habits during the period immediately preceding our birth, than if she had given us gin or opium immediately afterwards to keep us quiet and ensure her own repose; for the younger the child, or the more immature the stage of development of the fœtus, the more far-reaching are the consequences of nerve poisons, or other factors in the environment, which interfere with normal growth and nutrition.

Now it is obviously futile to express regrets for what might have been, or to lament the fact that we had not some say in the conduct of our parents' lives, but no doubt if we had been able to direct them according to our present ideas, we should be very different individuals from what we are to-day. Nevertheless, though the retrospect be gloomy, and the present none too cheerful, the outlook for the future is full of hope, because when we remember that our foundations date back through an im-

measurable past, and when we think of the crushing momentum of heredity, we cannot regard as otherwise than contemptible the insignificant influence of a few generations living under even the worst conditions of modern civilisation. The great force of heredity, moving with vast momentum in the direction of health, may have been temporarily resisted and deflected into morbid channels by the rude and repeated shocks of what is worst in civilisation, but none the less it can and will return again to its normal path, if only for a few generations we apply the compensatory forces of simple living.

It must be a comforting reflection to all those who speculate on the ultimate destiny of the human race to remember that a few false steps in the past are not irreparable, and that a few bricks laid awry in our vast foundations will be lost in the multitude of those that are laid aright. In educating the mothers of the present generation how to lay bricks correctly, we are training up a legion of good masons for the future.

If I could have my way, I would have these golden truths preached from the housetops. I would call a truce to all false modesty, and have every child, every boy and every girl, taught the fundamental principles of heredity

and life—not by allegory or cryptic references to doctors' bags and gooseberry bushes, but by those beautiful illustrations of fertilisation among flowers and simple forms of animal life that teach us all we want to know of the responsibilities involved in the continuation of life.

Now that I have explained to you the manner in which the conduct of our forebears may temporarily affect the health of succeeding generations, let me descend from general principles and consider some of the practical duties incumbent on the expectant mother, if she is to produce strong and healthy offspring.

The only food that the fœtus receives in the mother's womb is derived from the blood that circulates in her veins. This nutriment, like the food supplied after birth, may be either good or bad. Among the poorer classes it is often thoroughly bad, and in the higher strata of society it is often of little better quality, for it is dependent not only on the food the woman eats herself, but also on her digestion, on her habits of life, and on the presence or absence of disease. All these separate factors require independent consideration, and, as it is the most important, I will first ask your attention for a few minutes while I refer to the question of *food*.

Now it is a very curious circumstance that during pregnancy women are liable to develop morbid tastes for all sorts of food which they should leave alone. In extreme cases these perverted appetites may take the form of cravings for actual dirt, just in the same way that children of unstable nervous equilibrium suffering from certain forms of indigestion may unaccountably take to habits of eating coal or other dirt.

Unfortunately, however, there is a popular and somewhat widespread belief that morbid cravings of this kind in pregnant women should be indulged, because if allowed to go unsatisfied there is a risk of the embryo or fœtus developing into a discontented, disappointed child. The foolishness of this reasoning is of course self-apparent in those extreme cases, in which the morbid taste takes of the form of actual dirt eating, but in its minor manifestations, as, for instance, when the woman takes a dislike to the foods that she usually eats, or evinces a craving for green apples or some other sour food, the truly pathological significance of the symptoms may escape notice, and the necessity for suppressing the inclination may not appear urgent.

It is of the utmost importance to the developing fœtus that the food taken by the mother

should be of the simplest, purest and most nutritious character. By simple I mean food that is in its natural condition, and not highly seasoned or spiced; by pure, I mean, not contaminated by keeping, or so-called preservation; and by nutritious, I mean, adapted for the growth and development of sound and healthy tissues. For example, kippers, bloaters, dried haddock, high game, condensed milk, tinned lobsters and salmon, canned fruit, pickles or decomposing cheese, most of which are very popular dainties according to the ideas of the majority of poor people, and more especially so to those of pregnant women, who, as I have already said, have special cravings for what is bad for them, should, for the benefit of the developing fœtus, be replaced by simple roast or boiled meat, plain fish, milk puddings, fresh or stewed fruit, and green vegetables. Excessive tea or coffee drinking, and, above all, the abuse of alcohol, have most pernicious effects. It is commonly supposed that tea upsets the digestion by reason of the tannin it contains; it is possible that it partly owes its noxious properties to this cause; but intemperance with respect to tea is to be condemned for a much more potent reason, namely, that it contains an alkaloid or active principle called theine or caffeine, which has a

stimulating influence on the nervous system. I suppose all of us have experienced the refreshing or invigorating effects of a cup of tea when we have been tired or exhausted, and no doubt from this point of view a great deal may be said for our national beverage when taken in strict moderation. Nervous symptoms, such as palpitation of the heart or flatulence, are most common among those who indulge to excess in these beverages.

Caffeine, theine and alcohol are all diffusible nerve poisons, and as diffusible nerve poisons they can reach the fœtus through the circulatory channels of the mother, and exercise a malign influence on its nutrition generally, and on its delicate and impressionable nervous system in particular, in the same way, only to a much greater degree, that they affect the mother herself. All stimulating beverages, as well as highly seasoned or spiced dishes, should be avoided by the expectant mother for the following reason. *If the fœtus has been accustomed to a stimulating dietary during its term of intra-uterine development, if it has been nourished on a blood loaded with the products of rich living, the change to a simple bland diet of milk and water, such as is usually supplied after birth, is acutely felt.* This is an instance of

a physiological effect, following on a definite cause. I could give you many instances of the same kind. I dare say most of you can recall cases of children who have lived, if they have not flourished, on bloaters, cheese and pickles, and who have disappointed the purposes of charity by languishing in philanthropic institutions where the food, though good and plentiful, was plain. And among the upper classes, boys who have shared with their parents the gastronomic dainties of a French chef, often suffer in nutrition when they go to school, and are only provided with plainly cooked food.

Over-stimulation of all kinds blunts the edges of sensory nerves, no matter what purpose these nerves subserve. If you have a bright light flashed in your eyes on a dark night, for some time afterwards you can see nothing where all before was visible. If you hear the report of a big gun, you may become temporarily deaf, and so it is with the fœtus, when its nutrition has been stimulated by rich living; it seems incapable of responding to the mild stimulus which is provided by a simple milk diet.

If a *fœtus* has been stimulated before birth, the *infant* must be stimulated also, or it will not thrive. Sometimes meat juice, meat extractives, or anything, in fact, that will quicken the

digestive, assimilative, and nutritional processes may be required. If the fœtus has passed its antenatal existence in an environment of alcohol, that is to say, if the mother has indulged in spirits or strong wines, the infant stands a better chance of surviving if at first the stimulating treatment be continued, and small quantities of brandy or other spirit be added to the bottle. Anybody who has had much experience of the treatment of infants born of alcoholic mothers will bear me out that they are exceedingly difficult to rear. An appreciation of the principle I have enunciated will certainly lighten the task. When we come to think what a very obvious conclusion it is that any individual who has been living under a stimulating environment must languish when the stimulation is withdrawn, one cannot help being surprised that the practical applications of this principle are so frequently disregarded. Although among the better classes of Society the fœtus " in utero " nearly always has some alcoholic experience, I do not for one moment suggest that this experience is a very trying one, or one particularly detrimental to its interests. On the other hand, if my own observations can be relied upon, I should say that middle and upper class mothers are more flagrant offenders

in respect of poisons, which in their way are quite as harmful to the growing fœtus as is alcohol itself. I refer to drugs like phenacetin, antipyrin, aspirin, sulphonal and trional. These drugs are indiscriminately employed by pregnant as well as by other women, for the relief of neuralgia, sickness and insomnia, but whatever excuse ordinary women may be able to offer for resorting to drugs of this nature, it is clearly a very different thing, when the interests of another individual have to be considered. All these anodynes or narcotics, like chloral, ether, chloroform and alcohol, have a most marked and immediate effect on the nervous system—they could not be so efficacious in the relief of pain and in the annihilation of consciousness if they had not — nevertheless, one and all are nerve poisons of a most pronounced type, and, as I have already said, their influence for evil on the tender and impressionable nerve structures of the developing fœtus must be very great indeed. I never hear of an antenatal drug experience for a fœtus without fearing for the future of the infant, and I may say that I find my fears very seldom prove unfounded. I have at the present time under my charge at this dispensary a woman who has been a most acute sufferer from a very severe form of asthma. I

have been at my wits' ends to know what to do for her. She is now in the sixth month of pregnancy, and for the last three months I have been compelled, for the relief of her symptoms, to give her a number of drugs, which I know must have a detrimental influence on the nutrition of the developing fœtus.

Now I think if the subsequent fate of the infant* which will shortly be born is carefully watched, it will bear out what I have said on the subject of the influence of antenatal drug-taking on the eventual condition of nutrition of the child, and I hope that the unwilling share I have taken in the prospective damage to this still unborn child may not have far-reaching consequences.

Civilisation has rendered the lot of the pregnant woman extremely hard—want of physical exercise and laborious occupations very often combined with the results of rickets in early infancy, have combined to make the modern pelvis in women too narrow for the passage of the modern fœtal head. The dangers attendant on the actual confinement are only equalled by the extreme discomforts of the period which immediately precedes it. Indi-

* This infant is now attending at our Infant Consultations and is of a most degenerate type. Sep. 1906.

gestion, constipation and neuralgia—all products of modern civilisation—contribute their quota of trouble, and difficult as it is to do without drugs for the relief of symptoms of this character, I would remind you that there are other expedients that are worth trying first; let us make use of hydropathy, rational hygiene, diet, exercise, massage, or anything you will, rather than drugs. If it is necessary to protect growing children by means of legislation from the influence of alcohol and tobacco, how much more is it necessary to protect the susceptible fœtus from poisonous influences which reach it through the maternal channels.

If the *quality* and character of the food consumed by the pregnant woman determine the condition of her blood, and consequently the manner in which the fœtus is built up, let it not be forgotten that the *quantity* also is a matter of importance. There is a popular tradition that women in this condition require much more food than under normal circumstances, for the reason that there are two mouths to feed where there was one before. I am very glad to see that Dr. Ballantyne, than whom there is no greater authority on the subject of antenatal hygiene, brings his great influence to bear on the cause of moderate alimentation for pregnant

women. There cannot be a question that most of those who can afford to do so, eat more than is justified by their nutritional requirements, or by the physical work they perform. This intemperance of appetite is the result, as it is the curse, of civilisation—it represents partly a habit which is acquired in early infancy and childhood, and which persists throughout life, and partly a result of over-development of the organs of digestion. In other words, we create a vacuum, and then feel excessively uncomfortable if we do not fill it up. This sense of discomfort we call hunger; but it is not natural and healthy hunger; it is the exacting, selfish importunity of a spoilt child, which we have placed on a pedestal of such exalted importance, that quite unconsciously we allow it to dominate our lives, and introduce all sorts of discords and disharmonies between one bodily function and another.

I cannot here refer to all these discords, or even to many of them, but I particularly wish to draw your attention to one of them, for it very closely concerns the prosperity of the fœtus. *This discord is the poisoning of the system which results from the decomposition of food in the bowel.* There is not one of us who does not suffer in some degree or other from this

form of self-poisoning, "*auto-intoxication*," as it is usually called. Most of us seem to stand the strain fairly well, but it leaves us at the brink of a volcano, with very little margin of safety. Now the pregnant woman if she has two mouths to feed, has also two drainage systems to keep in order. She is constantly filling up one system herself with the products of decomposition occurring in her own bowel, while the fœtus, which has no independent sewage outlet of its own, pours all excretory products from its own system into the blood stream of the mother. Thus a very heavy strain is thrown on the scavenging resources of the mother, *i.e.*, on the liver and on the kidneys. And this is the reason why we watch with such anxiety the behaviour of the latter, when they are known to be, or when they are suspected of being, inefficient in their action. Albumen in the urine of pregnant women is always a very serious symptom, for it implies a breakdown in the important excretory functions which are performed by the kidneys.

If, then, under normal conditions all of us, women included, consume more food than we can safely dispose of, it is clear that when a woman becomes pregnant, she runs very serious risks if she greatly exceeds her usual diet and

supplements the degree of auto-intoxication. Not only should she not materially increase her diet, but she should facilitate the removal of all poisonous substances from her body, by flushing out the kidneys with copious draughts of mineral or plain water, by maintaining the functions of the bowels as efficiently as possible, by keeping the skin active, and by active healthy exercises.

I am sure it must be in the minds of many of you that this charge of overfeeding cannot apply to the majority of the women who belong to the class with whom we shall have to deal in our campaign of health. The whole question of sufficient and insufficient diet is, however, one of so much difficulty, there are such an enormous number of factors to be taken into consideration, and so many of our preconceived notions on the subject of diet have recently been proved to be wrong, that we ought to be very careful in expressing opinions on the subject, or in drawing deductions from observed facts. If an individual appears emaciated, thin and feeble, under circumstances in which it is possible that he or she may be suffering from actual starvation, we are very apt to jump at once to the conclusion that the condition is due to actual want of food.

Emaciation and malnutrition are, however,

far more frequently caused by auto-intoxication, the result of indigestion and incomplete assimilation of the food actually consumed, than by genuine want of food. Depression of spirits, worry, impure air and want of sunshine, are far more potent factors in the determination of malnutrition than is starvation. *Individuals who have a good digestion, and who live under favourable hygienic conditions, can thrive and flourish on a very limited dietary*, and the better the hygienic conditions, the more sun, the more air, the more cheerful the surroundings, the quicker are the vital processes, and the greater the need for food. These denizens of the slums are individuals in whom the vital activities, from want of air, of sunshine, and of all the other factors in the environment which act as stimulants to life, are reduced to the lowest level of vitality; if you provide them with what, according to our erroneous standard, is a full and ample diet, you do not quicken their vital processes and improve their nutrition, you only increase the degree of auto-intoxication, and heap coals on the fire that consumes them. These are some of the reasons why it is a dangerous belief to hold that pregnant women, and especially pregnant women living under bad

hygienic surroundings, require a very large dietary. The effects of maternal auto-intoxication are just as serious on the developing fœtus, as are the effects of extraneous poisons such as alcohol, opium, phenacetin or sulphonal. The upper classes chiefly owe their condition of auto-intoxication to an excessive intake of rich nitrogenous foods—the poor to an excessive intake of the cheaper carbohydrates, bread, biscuits, cakes and other farinaceous material. You will hear later what I shall have to say on the subject of the uses to which carbohydrate food is put in the animal economy, namely, that such food is only required for the purposes of supplying energy for physical work, and for maintaining the temperature of the body. Such food cannot be utilized for building up any of the essential structures of the body. Inasmuch as the fœtus is not called upon to perform much physical exercise, or, snugly enveloped as it is in a hot-water jacket, to undertake much combustion on its own account, it is perfectly clear that it will not require additional supplies of carbohydrate food —it only wants a small quantity of good nitrogenous food, and how little this is, you can judge from the amount of milk the infant requires after birth, when it has to keep itself warm, and

when it begins to take more active exercise. Half-a-pint of milk during the twenty-four hours is a large amount of food for the new-born infant. I hope you will remember this quantity when you see the expectant mother at the commencement of pregnancy taking an extra glass of milk, and possibly additional meals. *If an infant after birth only requires half a pint of milk per diem, you can easily estimate how much is wanted for the embryo during the early stages of development.*

Let me, then, frame a few golden rules of diet to be observed by the pregnant woman.

(1) The food of the pregnant woman is the material out of which the future offspring is built up; it should therefore be of the best possible quality, simple, plainly cooked, and unstimulating; it should consist for the most part of roast and boiled meat, boiled or fried fish, milk, milk puddings, fruit (fresh or stewed), vegetables, and farinaceous foods.

(2) The quantity should be adjusted to the habits and requirements of each particular case, but there is very seldom any need to greatly augment the usual allowance.

(3) Since the fœtus is, or should be, built up of nitrogenous foods, no useful purpose is subserved by increasing the proportion of carbo-

hydrate material. All excess of food tends to lead to auto-intoxication.

(4) Alcohol, tea, coffee, spices, sauces and pickles should be avoided as far as possible.

(5) Simple non-alcoholic beverages, mineral or plain water should be freely taken.

The next important point for consideration in the personal hygiene of the pregnant woman is exercise. No normally constituted person has ever succeeded in living in even tolerable health without physical exercise of some kind, and it is necessary for many physiological reasons, among others for the maintenance of a good circulation, as a direct incentive to lung expansion, and the removal of those waste materials which should be contained in all expired air, and which otherwise tend to accumulate in the system, and thus lead to auto-intoxication.

Deep breathing also ensures a free supply of oxygen, and although voluntary breathing exercises, taken independently of ordinary forms of exercise, may ensure the same end, nevertheless the involuntary and unconscious stimulus which is applied to the respiratory functions by physical exercise, is the most natural and beneficial means of ensuring an ample intake of oxygen, and a satisfactory removal of waste products from the body. Another important reason

for taking exercise is to bring about a complete combustion of food, which all of us, as the result of habit, take into our bodies in excess. If we wish to live an ideal, healthy life, we should regulate our intake of food, and especially carbohydrate food, by the amount of physical work we do, just as an engine driver receives a different allowance of coal in accordance with the length of the journey, the rate of travelling, and the weight of his load. This we seldom do, and we nearly always have a surplus over and above what we actually require for our organic purposes, and this excess often stands in the way between us and health. Muscular exercise, physical exertion, is the one safeguard we possess against an undesirable accumulation of carbohydrate reserves in our body, and the safest of all defences against auto-intoxication. There is still a further reason for taking exercise in moderation which deserves mention, and this is, that it has a quieting and soothing influence on the activities of the brain, and on the nervous system generally. *Exercise is the safest of all soporifics.* Our often too exuberant nervous system must have some occasional outlet for its reserve stores of energy; if this energy is not directed into useful channels such as those which belong to physical and intel-

lectual labours, it is quite certain to expend itself in some way and in directions we are not likely to appreciate, as, for instance, in the production of neuralgia, or insomnia.

Pregnant women are very apt to try and live up to the standard of invalidism that seems to be expected of them by their anxious friends, and to resign themselves gracefully to the attractions of the sofa. When they do so, natural sleep is often seriously interfered with, and then the temptation to resort to drugs too often steps in. On the other hand, physical fatigue, overexercise, or excessive exertion, bring consequences in their train which are no less disastrous, especially so during the period which immediately precedes the expected date of confinement. In some countries the employment of women in factories, or in works under public control, is forbidden by law for periods which vary between one month and six weeks before confinement. This is a very salutary and desirable ordinance, for there can be no doubt that a woman in this condition should be exposed to no circumstances which would be likely to precipitate a premature confinement, or prejudice her health previous to the trials and dangers of child-birth.

It is clearly an irrational proceeding to

attempt to define how much exercise should be taken by any particular woman; the "*optimum*" amount must depend on individual habits, constitution, and conditions of health, but regular exercise of some kind and of some amount is quite essential, if the child is to be born healthy. If possible, the exercise should be of a pleasurable character, and such as that to which the woman is habituated; ordinary house-work is just as good as any other form of muscular exercise, provided it is carried out under hygienic conditions, and in the presence of good ventilation. Monotonous exercise taken simply for health's sake often fails in its desired object, for the fatigue limit is much sooner reached than when it is taken for a definitely useful purpose, or for pleasure alone; the satisfaction of knowing that there is "something accomplished, something done," carries with it a psychological reward, which certainly deserves consideration among those other factors which conduce to the health of the mother and child.

The mental condition of the woman during the period of pregnancy is undoubtedly a matter of very great importance, but it is a subject on which one has to use very guarded language; for medical men and the laity hold very conflicting and opposed views as to the influence

of the mind of the mother on the course of development taken by the embryo or fœtus. According to popular belief, every monstrosity that is born, every case of Siamese twins, of hare-lip or webbed fingers, can be traced to some powerful impression made upon the mother during the period of pregnancy. It was not so very long ago that I myself showed to the " Society for the Study of Diseases of Children " a case of a girl who was born with one arm which abruptly terminated at the elbow : it gave an appearance as if the forearm had been cleanly amputated by a surgeon. There was, however, no scar, and only a little tiny nodule at the extreme end of the stump, which contained an incompletely developed nail. The mother ascribed her misfortune to the fact that, while she was carrying the child, she had been to " Barnum's," and had seen there a somewhat similar freak. She told me that she had received a terrible shock, and that she was sure the mutilated condition of her daughter's arm was due to this cause.

In a recent number of the " British Medical Journal " a correspondent records the following experience.

" A woman, about three months pregnant, was at a working party, when she suddenly

noticed that her neighbour was blessed with two thumbs on one hand. This, she declares, is a deformity which she had never even heard of before, and made a great impression on her. Her child, born six months later, has a very perfect supernumerary thumb on the right hand!"

Medical literature abounds in such instances, but the belief in "maternal impressions" is almost as old as history itself. No doubt most of you remember the Biblical legend in Genesis which relates how Jacob, when Rachel bore him Joseph and gave him his long-desired heir, wished to sever his connection with Laban as flock-keeper, and set up on his own account. Laban, who was greatly distressed at the idea of parting with one who had brought him so much prosperity, agreed to the following terms, if Jacob would continue in his service.

Jacob was to have for himself all the "speckled and spotted cattle, and all the brown cattle among the sheep, and the spotted and speckled among the goats." Then "Jacob took him rods of green poplar and of the hazel and chestnut-tree, and pilled white strakes in them, and set them in the gutters in the watering troughs when the flocks came to drink," and "the flocks brought forth cattle ring straked,

speckled, and spotted," and "the man increased exceedingly, and had much cattle, and maid-servants, and men-servants, and camels, and asses."

Old and firmly established, then, as is the tradition that maternal impressions exercise a powerful influence on the unborn offspring, Science, regarding the whole matter from a cold and dispassionate point of view, will not admit such interpretations. When these reported instances of freaks of nature depending on maternal impressions come to be investigated, it is generally found that the abnormality in development has been determined long before the supposed mental impression took effect upon the mother, and, even when this is not the case, some much more definite and dependable reason can be assigned. Nevertheless, there are very good and solid grounds for believing that the mental state of the mother has a distinct influence, not only on her own nutrition, but upon that of the fœtus also. We know how a woman's milk can be influenced by emotions and nerve shocks, and we know that epilepsy and other nerve storms can produce a toxic or poisonous effect on the blood, so that there is every reason for supposing that cheerful, bright and happy conditions of mind are just as con-

ducive to good nutrition in the fœtus as morbid fancies, depressed states of mind, melancholia, fits of temper and uncontrolled passion are conducive to the reverse results. The great chemist Liebig relates how a family of five persons suffered serious illness by eating the flesh of a roebuck, which had been snared, and had struggled violently just before death. Fits of passion, or even a hasty temper, extreme timidity, or fright may produce results similar but less deplorable; results which take the form of mild degrees of auto-intoxication, which not only influence the condition of the blood in the mother, but also of that which is supplied to the developing fœtus.

The Biblical legend of the ring-straked cattle may serve as an allegorical illustration of the influence of maternal states of mind on the physical development of the fœtus; if the surroundings, the environment of the expectant mother are gloomy and depressing, the prospects of her child growing into a healthy, and, consequently, bright and happy individual are most adversely affected; just as Laban's cattle and sheep and goats, which had nothing all day to think about except the piebald rods of poplar and hazel and chesnut, are related to have brought forth cattle, ring-straked, spotted and

speckled, so may the mother who gives herself up to her troubles bring forth children moody and melancholic. May I quote to you a little passage from the life of Charles Kingsley, which, if it does not literally and directly prove that calm and reposeful emotions in the mother have some influence on the ultimate development in the child, and if it does not prove all that the authoress herself believed, nevertheless, may it not, perhaps logically, suggest some causal connection between the placid moods of the mother and the disposition of the son? The passage runs as follows :—

" Charles's mother was a remarkable woman, full of poetry and enthusiasm. Keenly alive to the charms of scenery and highly imaginative, she believed that all impressions made on her mind before the birth of her own child by the romantic surroundings of her Devonshire home would be transmitted to him, and in this faith gave herself up to the enjoyment of the exquisite scenery of Holm, and Dartmoor, the Chase, the hills, and the lovely river Dart, which flowed below the grounds of the little parsonage ; and of every sight and sound which she hoped would be dear to her child in after-life. These hopes were realized, and though her little son left Holm when he was six weeks old, and never saw

his birthplace again till he was a man of thirty, yet Devonshire scenes and associations had always a mysterious charm for him."

When we think of this picture, and compare it with the miserable squalid environment of the majority of the prospective mothers in the slum tenements of sunless, gloomy London, can we wonder that our little street urchins have not the temperament of a Charles Kingsley? The poet Gray might well have been referring to these unhappy denizens of the slums, and not to the " rude forefathers of the Hamlet " of Stoke Poges, when he wrote in his immortal Elegy—

" Chill penury repressed their noble rage,
And froze the genial current of the soul."

CHAPTER II.

THE EDUCATION AT BIRTH, OR THE CARE OF THE NEW-BORN CHILD.

BEFORE birth the child lives a very sheltered life within the interior of the mother. After birth all the conditions are changed, and as an independent individual he has to do many things for himself which previously were done for him; he has to protect himself from many dangers for which the mother previously assumed responsibility.

The human baby is more helpless at the time of birth than the young of any other mammal, a circumstance which is closely related to the high degree of complexity of his organic make-up. He develops slowly because his highly complex organisation requires time for consolidation.

The human baby, unlike the young of lower animals, is possessed of a mother who by reason of her intelligence can protect him from the environmental dangers during the prolonged period of helplessness.

At birth the infant has to learn how to obtain and digest the food on which he depends for his

nourishment, he has to learn how to breathe and obtain oxygen for the purposes of combustion, he has to learn how to maintain the normal temperature of the body, how to remove waste material from the body, and how to protect himself from the attacks of living bacteria. I propose now to discuss in detail how he learns these very necessary lessons.

At birth the instinct to suck is so highly developed that there is little danger of the newborn infant dying from starvation if only he is put to the mother's breast and has a reasonable opportunity afforded him of obtaining the food which is elaborated by the mammary gland. There is, however, a genuine danger of this function of sucking becoming a most insistent habit if the child is put to the breast too often, or if he is allowed to suck his fingers or a comforter whenever he feels inclined. To avoid the establishment of this objectionable habit, *the infant should be put regularly to the breast, not oftener than every three hours* during the day, and never between the hours of ten o'clock at night and six o'clock in the morning. If this plan is adopted from the first day of life onwards, no trouble arises in connection with this function, and regular habits of sleep as well as digestion are firmly imprinted on the nerve cells.

The educational value of colostrum cannot be exaggerated, it is almost a perfect medium for teaching the stomach how to digest milk. Colostrum is little else than lymph which has exuded from the lymphatics or blood vessels of the mammary gland until the latter organ assumes the function of secreting true milk—usually some three or more days after the birth of the child. *It is impossible to conceive of any food with less irritating properties than colostrum;* in fact, there is very little difference between the colostrum which is the normal food of the infant for the first few days of life, and the blood of the mother which is its exclusive food for the nine months before birth. Colostrum therefore excites no violent reactions in the stomach of the baby, it does not act as an aperient as is usually supposed, and, further, it can be absorbed into the blood without any change being effected in it by the digestive processes. This latter property is of immense importance, for at the time of birth and for some days afterwards the infant is incapable of performing any digestive processes for himself. The change from colostrum which requires no digestion to milk which must undergo comparatively complicated digestive processes before it can be absorbed occupies a period of several

days and is gradually brought about by natural influences.

There is no known means of avoiding this gradual education : any attempt to feed the infant by artificial means without some such graduated method of education is almost certainly foredoomed to disaster. *The same objection applies to the feeding of new-born infants on the milk of wet nurses in full lactation ;* if such an attempt be made, the infant is not only cheated of the educational advantage of colostrum, but, further, his stomach is often flooded with unduly large quantities of milk. The amount of colostrum which the infant obtains from his own mother does not, as a rule, amount to more than half an ounce in the first 24 hours ; the amount of milk which an infant can obtain from a wet nurse whose milk supply is fully established may easily be 10, 15, or 20 oz., according to the vigour with which the infant sucks. It is not difficult to understand that the complicated secretory and motor functions of the alimentary tract may thereby be completely disorganised from the very first. It is most unreasonable to expect that if natural feeding by the infant's own mother proves a failure, that artificial feeding is likely to succeed. Even under the most favour-

able circumstances difficulties are likely to arise in connection both with the establishment of the digestive processes in the infant and with the establishment of the mammary functions of the mother, especially if she be a primipara. It is indeed unfortunate that so little patience is manifested in securing the establishment of lactation, a very large number of infants are relegated to the bottle on the third and fourth day for the reason that lactation has not been fully established at this date. As a matter of fact, the mammary gland often does not become fully functional until very much later. I have known more than one instance in which the delay has been for more than ten days. *Very few women ultimately fail to give a good supply of milk if patience is exercised* and ordinary precautions taken. It is a far more difficult matter to bring a living child into the world than to maintain it at the breast after it is born ; any woman who is capable of overcoming the first difficulty can almost certainly overcome the second. Professor Pinard reports that out of 12,000 births taking place in lying-in institutions in Paris at the beginning of the war, when there were urgent economic reasons why infants should not be relegated to the bottle, there was hardly a single instance in which the difficulties of breast-

feeding could not be surmounted. My own personal experiences confirm those of Professor Pinard.

The gradual change from colostrum to milk, and the gradual increments in the amount of food supplied during the early days of life, have a very important bearing on the co-ordinated development not only of the gastric, but also of the intestinal functions. The stomach and intestines have a great deal to learn during these early days beyond the mere digestion of food. The stomach has to learn how to admit and retain milk within its interior so that the digestive processes, as far as the stomach itself is concerned with them, may be completed. This involves many complicated operations, including the opening and shutting of the œsophageal aperture, the relaxation and closure of the pyloric sphincter, as well as the churning and peristaltic movements of the stomach wall. *If these motor functions are gradually elicited by appropriate stimulation, their development proceeds on normal and physiological lines.* If they are in any way overtaxed or overstrained, they develop on abnormal and pathological lines. One of the commonest results of overstimulation by excess in quantity or by the indigestible character of the food is the develop-

ment of a habit of vomiting, a habit which may become so ingrained that it can only be broken with the greatest difficulty. Habit vomiting of this kind may depend on violent and inco-ordinated contractions of the stomach wall, on spasmodic closure of the pyloric sphincter, or on undue relaxations of the œsophageal opening.

The motor functions of the intestines are correspondingly influenced by the behaviour of the stomach, and are, to a very large extent, dependent on them. If these functions develop on abnormal and inco-ordinated lines, the infant becomes troubled with spasmodic and painful peristaltic contractions which give rise to symptoms of colic and so-called "wind."

The normal development of the function of defæcation is of immense import, not only from the point of view of present health and comfort, but also from the point of view of the future. In the same way that colostrum has been shown to have educational influences on the development of the gastric digestive functions, so has meconium with respect to the establishment of the functions of defæcation. For the benefit of those who do not know what meconium is, it may be mentioned that it is the greenish black material of the consistence of treacle which fills

up a considerable part of the intestine at the time of birth. It consists chiefly of mucus, bile, epithetial detritus, and other substances which the fœtus may have swallowed during the intra-uterine life, that is to say, substances such as hair, etc., contained in the amniotic fluid. The amount of meconium contained in the intestines at the time of birth is quite sufficient to form the basis of a considerable number of stools, and, as a matter of fact, the ordinary motions of the infant during the first three or four days of life consist exclusively of this material. When, after birth, the respiratory movements are established and gentle peristaltic contractions of the intestines are elicited by the act of sucking and the intake of small quantities of colostrum, there is a tendency for some of the meconium to be squeezed into the pelvic colon and rectum and to cause a certain amount of distention of their hitherto undilated cavities. When this distention has reached a certain intensity it acts as the stimulus for those contractions of the rectal wall and its associated extrinsic muscles which finally result in relaxation of the anal sphincter and the expulsion of the rectal contents. Inasmuch as the time occupied in the descent of the meconium will vary with the intervals between feeding and on other

concomitant conditions, it follows that the number of times that the bowels will open during the early days of life will largely depend on the number of times that the child is fed, and also, indeed, on the character of the food. Since the action of the bowels is very largely a matter of habit, it is clearly of importance that care should be exercised in establishing habits of favourable augury. *By frequent feeding it is very easy to induce an habitual form of diarrhœa,* while it is easier still to induce a habit of constipation by adopting the popular practice of clearing out the meconium from the bowel during the early days of life by a dose of castor oil. If the meconium is evacuated by such means, no material remains in the bowel to form the basis of subsequent motions, and hence no stool is passed unless a further dose of castor oil or other irritant is administered which causes a free secretion of mucus—a most unsatisfactory substitute for meconium. It is not until lactation has become fully established that the newborn infant can obtain, apart from meconium, the where-with-all to provide a satisfactory basis for a motion : during this period, it is obviously of extreme importance that the presence of meconium should be conserved within the bowel as zealously as possible.

The same necessity for care in the establishment of such an apparently uncontrollable function as that of breathing must be observed in order that bad habits may not be acquired. *There is a great danger of the new-born infant starting his career as a mouth-breather,* and continuing to remain such for the rest of his life, for the airway through the nose is often obstructed owing to the flattening out of the nose as the head passes through the maternal passages, and also because the nostrils are often plugged with mucus. When such obstructions exist it is easier for the infant to breathe through the mouth which can be opened to any desired extent, than through the natural channels; a habit of this kind arising on the first day of life is apt to become permanent.

Even in those cases in which a habit of mouth-breathing is not established during the first few days of life, it very readily becomes so later on if for any reason the naturally narrow airways through the nose become encroached upon by swelling or turgescence of the mucous membrane. Such swelling very readily occurs if the olfactory mucous membrane is irritated by air which is too cold, too dry, or too impure. The function of the nose is to warm, moisten and purify the air before it enters the lungs; if any

of these functions is overstrained, the mucous membrane becomes congested and probably catarrhal. For these reasons it is necessary to take steps to secure for the new-born baby air which is warm, moist and clean.

In connection with the circulatory system there are several points worthy of consideration from the point of view of education: a well-regulated distribution of blood throughout the body is an essential condition of health. If the organic functions are to be properly performed, it is requisite that blood should be supplied freely to those parts which are active at the expense of those which are at rest; for instance, during digestion blood should be diverted to the abdomen, and during sleep blood should be diverted from the brain. Although the temperature of the internal parts and of the blood generally must be preserved at all costs, none the less it is essential for the comfort of the individual, be this individual infant, child or adult, that no part of the body should be seriously chilled. If any individual is exposed to great external cold the general temperature of the body would run a serious risk of falling to a dangerous level were not the blood driven from the surface where it is most exposed to cold to the more protected internal parts. Contrawise,

if for any reason the general temperature of the body is in danger of rising above the normal level, it will be brought to the surface where it has an opportunity of being cooled. The proper distribution of blood under these, and many other varying conditions, is exclusively under the control of the nervous system. The particular part of the nervous system which carries out these functions is known as the vaso-motor system, which consists of very widely distributed nerve centres in the medulla, spinal cord and periphereal sympathetic nervous system. These vaso-motor centres act in very close association with the heat-regulating centres to which reference will be made on page 168, and which, like them, depend for their efficient working on adequate training and experiences.

At the time of birth the distribution of blood throughout the body is most ineffectively controlled by the vaso-motor nerve centres, for the reason that heretofore they have had practically no opportunity for exercising their functions. If, however, these centres are submitted to the right kind of experiences and are properly trained, they soon become very efficient in the performance of their duties; if they are submitted to serious strains, they break down in

function or assume faulty habits in exactly the same way that the stomach or intestines learn faulty habits if they are wrongly handled. If at the time of birth elaborate precautions are not taken to maintain the blood temperature of the infant, there is a serious risk of the blood being driven from the surface where it is exposed to cold, into the internal parts where it is better protected. In such an event the feet and hands and other exposed parts will become cold, and this diversion of the blood is apt to become habitual even after the necessity has been removed. *Cold feet, in the vast majority of cases, are the result of habit engendered during the early days of life* by careless methods of management. If the vaso-motor centres are to be well educated, the lessons they first receive must be of the simplest character, but as their functions become more efficient and stable the experiences to which they are exposed must be extended. At first new-born infants should be kept exceedingly warm, so that there is no possible risk of a lowering of blood temperature; later on the same care is not necessary, changes of temperature do good, and expedite the educational curriculum. The individual in hard condition, who can sleep in the open and maintain his temperature, is the individual whose

vaso-motor centres are well-trained and in good working order. The individual who is always kept in warm rooms, who is always wrapped in warm clothing, and never has any but a hot bath, is an individual who must necessarily have badly-trained vaso-motor centres; is, in fact, what is commonly regarded as a "soft" individual, and very readily becomes chilled on exposure to cold.

One of the most important educational tasks of the new-born infant is that of acquiring the power of self-defence against bacterial infection. At first his defences are very feebly developed, but with time and experience he soon becomes fairly expert in dealing with invading microbes. Few infants are born completely immune to any of the common infective diseases, but their degrees of susceptibility vary enormously. A considerable part of childhood is occupied in acquiring immunity to exanthematous and other infectious diseases; most children are attacked by measles, chickenpox and whooping cough, a good many also have German measles, scarlet fever, diphtheria and para-typhoid, but after one attack they are more or less immune for the rest of their lives. No doubt a fully-developed attack of any of these diseases is a somewhat drastic

method of acquiring immunity, but the lesson learnt is seldom forgotten, while the loss of time is, from an economic point of view, not nearly so serious as it would be if these diseases were incurred during adult life. Young infants seldom fall a prey to any of the above infective disorders; in fact they appear to have a partial immunity to them which may be due to the fact that the blood which circulates within their system is the same blood as that which circulates within the mother; if the mother has a relative immunity to these diseases owing to previous attacks it is quite understandable that the child may also show a comparable resistance owing to similar properties in his own blood. This inherited immunity may disappear after a time owing to the elaboration of new blood without such properties. I am personally very strongly of the opinion that the enhanced immunity which breast-fed infants, as compared with bottle-fed infants, show towards infective disease is largely due to the protective influence of the mother's milk, which there are reasonable grounds for believing contains certain protective bodies. If this view is correct, there are good grounds for confining, as far as possible, the new-born infant to the environment of his own mother, and not placing him in the care

of strangers, and submitting him to all the risks of artificial feeding.

The new-born infant who is breast-fed and cared for by his own mother is mainly exposed to infection with organisms which reside in, or on her own person. The mother is herself immune or resistant to her own bacterial flora; she is, in fact, a safe " carrier " of germs which might possibly provoke pathological reactions in the tissues of another individual. As long as the infant has circulating in his system the blood of the mother, or is reinforced by a supply of corresponding protective substances in her milk, he may remain free from infection and in good health. On the other hand, he will not necessarily show resistance to a different series of bacteria originating from the person of a stranger. *For this reason I regard it as one of the most essential elements of good mothercraft that an infant should be nursed by and remain in the exclusive company of its own mother.* It may here be remarked that dangers do not arise exclusively from these specific organisms which give rise to definite diseases such as measles, whooping cough, summer diarrhœa, or pneumonia; there are a whole host of organisms of the nature of staphylococci, streptococci, septic, catarrhal and coli bacilli, which are

capable of evoking serious symptoms in unprotected individuals. A child's life is a long series of contests with these and similar organisms. Unless the child is overwhelmed in the early days of life by reason of numbers, or diversity of species, he soon acquires a relative immunity to all of them.

The organism bristles with mechanisms for resisting the invasion of bacteria, but during the period which immediately follows on birth, these various defences are only partially developed. The main defences consist of the following :—

1. The defensive armour of an intact skin and mucous membrane.
2. The defensive activities of the white blood corpuscles or phagocytes.
3. The elaboration within the blood and tissue juices of various protective antibodies.

Owing to the fact that the skin of the newborn baby is soft and macerated due to its prolonged immersion in amniotic fluid, abrasions and small lacerations can very easily occur on the surface which are capable of permitting the entrance of bacteria between the joints of the armour plating. In the thick coating of vernix caseosa (cheesy varnish) with which the body

of the infant is richly provided at the time of birth, a natural provision seems to have been secured for the prevention of infection through this route. When, however, this protective coating is completely removed by the ablutionary administrations of the midwife, the skin is left in a particularly defenceless condition. *Care should therefore be exercised to do the skin as little damage as possible in washing* or *in drying* the infant, and in my opinion the skin should be liberally dusted with Fuller's Earth or other fine toilette powder. It will be generally noticed that skin infections of the nature of small pustules or eczematous rashes develop, for the most part, in those situations such as the scalp, face, neck and folds of skin which are most frequently washed, least efficiently dried, or most exposed to irritation of some sort.

Finally, mention may be made of the peculiar liability of the mucous membrane of the mouth to become the seat of small injuries through too energetic cleaning of the buccal cavity with pieces of linen soaked in boracic lotion. *The fungus of thrush does not readily find a lodgment on the intact and healthy epithelium which lines the mouth;* it finds, however, the damaged mucous membrane most congenial soil.

In this brief account I have referred to a few

of the dangers which beset the new-born infant, and I have attempted to show how to some extent they may be counteracted by judicious educational methods. The reader will readily understand how vast is the field for further development and extensions on these lines.

CHAPTER III.

THE FEEDING OF INFANTS: CERTAIN GENERAL PRINCIPLES.

THE hand-rearing of infants is a matter on which ninety-nine people out of a hundred imagine that they are competent and qualified to speak. My apology for doing so on this occasion is that I have spent many years of my life in attempting to acquire some elementary knowledge of the subject.

Just as in time the rope will wear away the rock, so in time may we, by patience and perseverance, hope to dispel those deep-seated prejudices and erroneously conceived notions on the subject of infant feeding which are responsible for much ill-health.

I hardly like to suggest to you, who probably have far better qualifications in this respect than I have myself, that individual tact in a venture so difficult as that on which we are embarking is almost as important an element of success as scientific knowledge. Nevertheless, I believe that suggestion will be found the readiest means of persuasion. If by a little timely sympathy and tact you can induce a mother to suggest for

herself the very remedy you propose, half the battle is won. It is unwise to let her think your advice is of the nature of special pleading, or that you hold in your portfolio a mission of inspired authority.

It is a mere platitude to observe that the problem of artificial feeding lies in finding a substitute for maternal milk which corresponds to it in essential particulars: it would be a similar platitude to mention that the problem still remains unsolved. Nevertheless, let me explain to you in what respects the artificial substitute can correspond with the breast-milk, and in what respects it fails to do so. In the first place, it is quite easy to find a substitute for human milk, which is equally nutritious—that is to say, one that contains exactly the same proportions of the chief food elements. In the second place, it is quite easy to find one that is equally easy of digestion: indeed, it is no difficult task to find one that can be far more easily digested; it is not so simple, however, to find one that is so free from contamination, so free from microbes and bacteria, and, last but not least, it is hard indeed to discover one that is so capable of training the stomach to digest normally. This question of gastric education is one that is so consistently neglected, so per-

sistently ignored, that I make no apology for placing it at the head of the list among all the *desiderata* in substitute feeding, and for asking your special attention while I explain to you my reasons for giving it this privileged position.

Education has been defined as "*the provision of an environment, the function of which is to prepare for complete living.*"* This definition, which of course embraces every department of education, applies accurately to the education of the stomach. Unless you provide the stomach with a food which prepares it for digesting all articles of diet, you are no more justified in expecting it ultimately to perform its natural functions in a normal and orderly manner than you are justified in expecting a child who has never been taught its notes to become an expert musician.

Unfortunately, it is inherent in human nature to look to immediate results rather than to remote ends, and, as I have already said, the whole subject of gastric education has been so completely neglected that many of us are unaware that, although the immediate result of any food or method of feeding may be highly satisfactory when estimated from the view of present advantages, nevertheless, when re-

* C. W. Saleeby. Individualism and Collectivism.

garded from the point of view of prospective results, it may be a lamentable failure.

Now let me explain to you some of the objects of gastric education. The stomach of the infant and child must be taught to digest and tolerate a large number of different varieties of food, for ultimately it will be called upon to digest all those heterogeneous varieties of food which are included in human dietaries. The stomach must be taught to break up and disintegrate solid substances taken into its cavity by keeping up constant churning, rotatory movements as long as any solid food remains. And it has also to be educated to secrete the gastric juices that liquify the food thus ground up, and to empty itself when digestion is completed; further, it must learn to rest tranquilly and patiently when empty so that it does not disturb its owner by restless and impatient activity.

Now I suspect that the majority of people imagine that these gastric functions develop without control or guidance. I can assure you that this is not so, although under normal conditions of breast-feeding Nature carries out her scheme of education so unobtrusively that we hardly give her credit for the long-sighted policy she adopts. All animals, from man downwards, which belong to the class of mammals, that is to

say, all animals which suckle their young, provide a milk which, in addition to fulfilling many other necessary conditions, is exactly adapted for the purpose of education.

Let me take, as an instance, the cow. You know how it gathers grass the livelong day and chews it all the night, you know also its habits of regurgitating food it has already swallowed for the purpose of rumination. When we consider the extremely un-nutritious character of the bovine dietary, its habits of rumination, and the enormous amount of food it must swallow if it is to maintain its existence and supply milk, we can hardly expect otherwise than that its stomach should be constructed on very special lines, and so it is.

I do not, however, propose to describe to you the anatomical details of the cow's stomach, but I think you will agree with me that if it is to perform the extremely difficult task of digesting grass, and if it is to accomplish the juggler's feat of rumination, it must receive a very special education while under maternal guidance. There can be no doubt that cow's milk is most admirably adapted for the purpose. Mild, innocent looking emulsion that milk undoubtedly is as stands in a jug on the British breakfast table, see what becomes of it if you add a little rennet.

In a few moments it sets into a jelly—a plaster of Paris cast of the vessel that contains it. This process is completed in the stomach of the calf, and occasionally in the stomach of the infant. For in both there is to be found a rich and ample supply of that curdling ferment which we know as rennet, and which is provided by Nature for the purpose. It is this heavy, ponderous curd that teaches the stomach of the calf to tolerate and digest the hay. A milk which is designed by nature for the education of a calf, and for the purpose of teaching it to digest grass and hay, and the subsequent regurgitation or vomiting of its food, is hardly the milk on which to commence the gastric education of the new-born infant?

From general observation I feel forced to the conclusion that there are a considerable number of people who imagine that regurgitation or vomiting in infants, like rumination in a cow, is not only a natural and harmless procedure, but that it is also a beneficent intervention on the part of Providence for regulating the amount of food that is retained in the stomach.

I am fully prepared to make the admission that, if the stomach is over distended, it may be the lesser of two evils that the superfluity be rejected; but two wrongs do not make a right.

As far as possible the young infant should not be encouraged to vomit. I hope I shall on a future occasion have an opportunity of speaking to you on the subject of the acquisition of habits good and bad; if I do so, among the bad habits will certainly be included the habit of vomiting. The stomach of the new-born infant, like the stomach of the new-born calf, is peculiarly sensitive to and resentful of rough handling; indeed, utter disorganisation of function is likely to ensue if it is exposed to the irritating influence of food which is foreign to its natural habits. A calf is made very ill if it swallows hay or hair, and many a hecatomb of infants have been sacrificed by the premature introduction into their stomachs of the very food on which a calf will thrive. I described to you and demonstrated to you the sort of plaster-of-Paris cast which is formed by cow's milk in the stomach of the calf; very much the same sort of thing occurs when it enters the stomach of an infant. The more the milk is diluted with water, or barley water, the lighter and more digestible the curd, but no matter how extreme the degree of dilution, some sort of clot is bound to be formed, and it is this clot that proves so fatal to infant life. Now the meaning I wish to convey to you is this, that although the infantile stomach is highly adapt-

able and amenable to educational discipline, nevertheless it does not commence its career with the same natural tolerance of cows' milk that is normal in the calf.

In practice I find it far more satisfactory not to allow any clot whatsoever to form in the newborn infant's stomach: I either peptonise the cow's milk, or simply give whey from which the curd has been removed, and then, almost drop by drop, I add milk, which still retains its clotting properties. This is, however, a counsel of perfection, and is not altogether easy in the class of case with which you will have to deal. I can only hope, therefore, that you will succeed in persuading the majority of mothers to commence their infant's gastric education on a system of breast-feeding—the transition from this to the artificial method, when such is necessary, is far easier than when you undertake artificial feeding from the very first. Artificial feeding, however, if scientifically employed, has this distinct advantage over natural feeding, namely, that you have under control the rate and the character of the educational process. It is true that colostrum, which is the name given to the milk which is first secreted by a mother, is different in character from the milk which is secreted when lactation is fully established, and

that it is better adapted for the initial lessons in digestion, but, nevertheless, when once the colostrum has been superseded by normal milk, there is a great want of elasticity in the educational curriculum. In breast-feeding there is no imposition of tasks of progressive difficulty.

Now while a very large number of artificially-fed infants have their digestions more or less permanently ruined by unwisely imposing impossible tasks, there is also a considerable number of babies on whom an equal injustice is inflicted by always having their work, so to speak, done for them; in other words, they are provided with a food that requires no digestion at all, and consequently they do not learn to digest at the very period in their lives when the lesson is most easily learned, the *only* period, I think I am justified in saying, when it is possible to learn this lesson properly.

The chief contributory factors to this condition of affairs are two in number, firstly, the tendency that is inherent in human nature to judge by immediate rather than by ultimate results, and, secondly, the wide popularity of artificial and patent infant foods.

These patent preparations fulfil, it must be admitted, certain important conditions which I have already referred to as essential in any arti-

ficial substitute for human milk. Indeed, if we put them to the crucial test which the writer of a popular little work on infant feeding suggests should be applied to all artificial foods before they are given to infants, many of them will be found to comply with *all* the requirements. Let me quote to you the passage: "The great *desideratum* in feeding an infant is that the food should be easy of digestion, easily assimilated, nourishing, and palatable." Submitted to these tests, many infant foods may be regarded as perfect. They are, of course, easily digested, or, rather, they require no digestion at all, and they are also easily assimilated; moreover, they are very palatable, and, if you judge by immediate and superficial indications, they are also nourishing. But, quite apart from other objections, and there are many, these foods deserve to be condemned on the ground that they neglect the educational aspect. This question of gastric education appears to me to be of paramount importance. Our object should be *to make a fine useful man, not only a fine fat baby*, and although the adage will not bear strict criticism, nevertheless there is much reason for agreeing with the saying, that "a man is no better than his stomach."

Let me next call your attention to the subject

of the nutrition of the infant. This question, as I have already hinted, must not be exclusively regarded from the point of view of present advantages; ultimate benefits have also to be taken into consideration. We must remember that the stability and endurance of the whole superstructure depend on the manner in which the foundations are laid in infancy.

Every mammal is provided by nature with a milk that satisfies the nutritional requirements of the offspring. The requirements are partly those of growth, partly those of upkeep, partly those doing work, partly of producing heat, partly of elaborating secretions, and there are all the different elements in the milk which are adapted to these different purposes. As the rate of building and the expenses of upkeep differ in various species of animals, so do the proportions of the different constituents in different milks vary also. The milk of every animal contains its due proportion of nitrogenous material, its due proportion of fat, of sugar, of salts, and of all the elements which are necessary for the purposes of life. Let me, then, examine the nutritive properties, or the different uses to which these various constituents are put in the animal body, and let me explain why they are present in such varying propor-

tions in different varieties of milk. Commencing, then, with the nitrogenous elements in milk, let me remind you that these consist of the clot, coagulum or curd which we find separated in milk when rennet is added to it; there is also a small quantity of albumen always present in the whey, from which the curd has been removed. The nitrogenous elements of milk are, in fact, special varieties of albumen, and they serve exactly the same purpose in the growing baby, that meat and white of eggs serve in the economy of the adult individual. *These nitrogenous or albuminous substances are used by the animal for building up all the essential parts of the body, for effecting repairs, and for manufacturing secretions.* It is perfectly clear, therefore, that they fulfil very important functions—indeed, so important are these functions that as a class these varieties of food have been called proteids or proteins, which means first, or to be first.

Recognising, then, the fundamental fact that albuminous material, or proteid matter, is essential for the building up of the body, the inference is unavoidable that a growing organism requires more of this class of food than one that is mature. Hence my insistence on the importance of training an infant as early as possible to

digest these nitrogenous foods. *Animals which grow very rapidly, and reach maturity at an early age, are supplied by nature with a milk that contains a relatively large proportion of proteid matter.* Thus you will notice that the lamb receives about three times as much, and that the puppy receives almost five times as much protein as the baby.* It is true that the young of any animal can grow in size on a diet that is very deficient in nitrogenous material, but the growth is rather of the nature of fat and useless tissue, than of essential structures, such as bone and muscle. I believe that it is practically impossible for any infant to continue for many weeks in succession to put on more than six or eight ounces of nitrogenous tissue. And very few can put on as much, although they can store any amount of fat.

The superficial attractions of those fat, rosy-cheeked babies, who have been fed on patent foods, and whose idealised portraits decorate so many of our street hoardings, have engendered in public opinion a very false estimate of what in a baby is worthy of genuine admiration. I advise you to cultivate a different taste in babies.

* Sheep's milk contains 5·74 per cent. of proteid. Bitch's milk 9·91 per cent. of proteid matter. Human milk 1·5 per cent. of proteid matter.

Personally, I admire those characteristics in a baby which I know to be auspicious for future health. I do not admire a peach-like complexion, and even a rosy one has no attractions for me. I like to see a baby full of life and animation and elasticity, one in whom the outlines of the muscles are not obliterated by fat—I like, in fact, to see what I know to be a nitrogenous baby.

It is a matter of common experience that animals which are rapidly fattened up for market on oleaginous and sugary foods, are very liable to apoplectic seizures, and to succumb lightly to disease. When slaughtered their carcases yield a comparatively small amount of lean meat; and even this shows indications of fatty degeneration.

A few years ago some very interesting experiments were made by Mr. W. A. Henry, of the Wisconsin Experimental Station in America, to determine accurately the influence of diet on the essential and non-essential structures of the animal body. For the purposes of his experiment he took a litter of pigs; half of them he fed nitrogenously, the other half were fed in the way that our patent food babies are fed. At maturity both lots were slaughtered and their carcases analysed. It was then found that the

nitrogenously-fed pigs contained nearly one and a half times as much blood as the others; their muscles weighed one-third more; and, what is a matter of very great importance, it took one-third more force to break their bones. *These experiments throw some very interesting light on the association that exists between rickets and deficient nitrogenous feeding.*

The next food element in milk that has to be considered is the fat or cream. After proteid or nitrogenous food, it may be said that fat is the most important and essential constituent. Cream is undoubtedly the best form in which to give fat to an infant, and chiefly so for the reason that it exists in a condition of fine division or emulsification; in this form it is most easily digested and assimilated. Fat may, however, be supplied to infants in the form of cod liver oil, salad oil, dripping, suet, lard, or butter, and infants can be very easily educated to digest these varieties almost as well as they can the natural emulsions. The chief use of fat in the animal economy is in the maintenance of the temperature. Fat is very combustible and gives out a great heat, and this fact is well recognised by the inhabitants of cold countries. Fat, however, subserves a mechanical as well as a nutritional function in the infant organism, for it

lubricates the bowel, and thus is a natural preventive means against constipation. No doubt fat is of service also in the elaboration and building up of the nervous system, but, although we are quite unable to explain exactly why the human baby is so dependent on the presence of fat in its food for normal development, nevertheless *we know by experience that, if the proportion of fat is unduly reduced, nutrition languishes, and a rickety condition is almost certain to supervene.*

Since these words were written, now many years ago, an important discovery has been made in connection with the existence in certain fats, more especially butter fat and other animal fats, of bodies known as Vitamines. These bodies are somewhat intangible substances, and appear essential for nutrition; growing animals especially stand in need of them; if they are deprived of them they cease to grow and suffer from certain forms of malnutrition.

The special vitamine present in fats has been called "the fat-soluble, accessory factor A." Owing to the presence in animal fats, such as butter-fat, cod liver oil, suet, etc., and their absence from vegetable oils, such as olive, linseed, and cotton seed oils, infants can only

thrive when they are provided with animal fats; they fail in nutrition after a time when they exclusively depend on vegetable fats.

Animals appear to obtain this vitamine from grasses and leaves which they eat. They store it up in the deposits of fat which exist in their tissues, or in the milk which they may secrete. Hence cows supplying large quantities of milk, or nursing mothers suckling their infants, should be provided with ample quantities of fresh green food. It is quite possible and probable that cows in the winter when they are stall-fed, and women living in towns and consuming little fresh food, may obtain a deficiency of the food whence these vitamines originate, and hence the infants who depend on their milk may be starved in accessory food factors which are necessary for good nutrition. This fact may explain why extreme fat starvation may lead to the development of rickets.

According to their habits of life, to the degree in which they are exposed to cold, to the degree of protection which their coats afford, so to some extent does the amount of cream in the milk of different animals vary.

A calf and a baby are provided by nature with about the same proportion of cream. It is true that the former has a warm coat to protect

it, and that the latter has a naked skin, but summing up the respective needs of the two for warmth which is derived from internal combustion, we may say roughly that the calf's coat and the exercise which it takes, counterbalance the dubious advantages which the baby enjoys from hot rooms and superfluity of clothing. Seeing, then, that a calf and a baby require, and are provided by nature with the same amount of cream, it is clear that we do a baby a serious injustice if we dilute cow's milk before we use it as an exclusive food. For reasons already given, however, this dilution is necessary; we must therefore make good the fat deficiency by giving the baby additional cream, or one or other of the substitutes I have already mentioned. Although I could tell you fairly accurately how much additional cream should be given to a baby, according to the degree of dilution of the milk, nevertheless I will not burden your memories with the exact figures, as it is very unlikely that, owing to the expense which its use entails, too much will be given in the poor households which you will visit. Two tablespoonfuls per diem, that is to say, about a teaspoonful in each bottle is a fair allowance. If you use a substitute fat, such as butter, or cod liver oil, or suet, you cannot pos-

sibly give as much as this at first, although later on, when the digestive functions have been educated up to the required standard, you may be able to supply an equivalent amount with advantage.

I now come to a third variety of food which is an essential element in all dietaries, whether employed for infants or adult individuals, and this variety of food is sugar. I use the term "sugar," although I should more properly have said "carbohydrate." The carbohydrate family includes milk sugar, beet sugar, honey, molasses, maltine, starch and many other foods, but from the caloric point of view they are all of exactly the same value. Some of them, however, are soluble in water, others are not; some are sweet to the taste, others are not. These two characteristics, solubility and taste, are very important from certain points of view, but they do not affect the question of nutrition.

If you or I eat a mouthful of starch, or a mouthful of rice or flour, we very soon convert it into sugar in virtue of certain digestive ferments with which we are provided, and as sugar it is absorbed into the system. You can convert starch into sugar quite easily outside the body. For instance, if you soak a small piece of bread in some water containing extract

of malt, or some saliva, both of which contain the same digestive ferment, and allow it to stand in a warm place, the insoluble starch of which the bread is composed is soon converted into sugar, or into a "*soluble carbohydrate,*" as it is called.

Now a new-born baby cannot digest an insoluble carbohydrate like starch: it must be provided with a soluble variety such as sugar or honey; it cannot do so because it has not yet learned how to secrete the ferment which causes the solution of starches. However, it is just as important to teach an infant how to liquify solid starch as it is to teach it how to digest or liquify solid albumen, such as the clot of milk. You can begin its education in this direction by giving it in the first instance barley water, which contains a small trace of semi-liquified carbohydrate, and you can advance it by proceeding to bread pap. If you thoroughly understand the dietetic identity of these two varieties of carbohydrates, that is to say, the soluble sugars and the insoluble starches, you will be saved from falling into the trap in which a large number of people are caught. Now you know how frequently invalids are told that they must abjure sugar for their health's sake, and you know the conscientious way they carry sac-

charine about with them and use it to sweeten their tea. But these same people eat buttered toast and farinaceous dainties without hesitation. The diabetic patient or the man with gout had much better adhere to his sugar and relinquish his potatoes and his toast; the one he takes in grains, the other in ounces, but both of them belong to the same carbohydrate family, and the only differences between them are those of taste and solubility.

I constantly hear mothers and nurses talk about "*strengthening*" baby's food by the addition of one of those patent preparations to which I have already referred; some of these contain soluble carbohydrates, some of them insoluble, but all contain carbohydrates and very little else. By no stretch of the imagination can they be supposed to strengthen either the baby or the food. In the pursuit of your work you will probably hear a good deal about the "strengthening" of babies' food, but if you have grasped my meaning, you will know that *the only way to strengthen the child is to build it up "nitrogenously" and to educate it in the due exercise of its functions.*

Now although sugar plays no part, or at least no essential part, in the building up of the human body, it plays none the less a very im-

portant part in providing energy for muscular work, in the same way that coal supplies the energy for the work of a steam engine. A man who earns his living by the sweat of his brow, or a foal that runs by the side of its mother, has considerable need of carbohydrate food for the supply of muscular energy, but the case of infants is different; the amount of work they do in the twenty-four hours is quite insignificant, and therefore their requirements for carbohydrate food are quite insignificant also, and nature allows for this in a wise provision of a diet that contains only the requisite amount of sugar. But when we leave nature, and rely on artificial means of feeding, we nearly always find the infant overwhelmed with sugar. If we feed a baby with too much nitrogenous material, as you know he generally gets rid of the superfluity by vomiting or regurgitation. Nature, however, provides no such safety valve in the case of excess of sugar; what is not used up for the supply of energy, or for the performance of muscular work, is disposed of by the organism in various ways; *part is burnt off like fat with the production of heat, and thus you will find most sugar-fed babies beaded with perspiration,* part of it undergoes fermentation in the bowel, with the production of acids which sour the in-

fant's temper, and with the evolution of gases which distend its belly and give it pain, and part of it is stored up in the body in the form of fat, or of glycogen, a more or less insoluble animal carbohydrate. The appearance—and I might add the smell—of these sugar-fed infants is very characteristic; they are often quite hard and firm, but their firmness is due to the deposition of fat and glycogen which distends the skin, and not to the tone and elasticity of healthy muscle. Owing to the superfluity of glycogen, there is a curiously translucent appearance of the skin which you never see in healthy individuals—young or old—you see it in beer drinkers, and you see it in patients recovering from typhoid fever or other debilitating illnesses; it is due to the rapid growth of unsound, unhealthy tissue which contains, as I have said, a preponderance of insoluble carbohydrate, or glycogen.

This completes all I have to say on the subject of the three main constituents of milk or any other complete dietary. As regards salts, I need say but little; cow's milk contains a larger proportion of them than is required by the growing infant, so that, even in its diluted form, there still remains enough for all ordinary purposes. The hardness of bone certainly depends upon the building up, or elaboration of

lime and other salts, *but there is no reason for thinking that the construction of bone is accelerated by the addition of lime water, for milk contains an ample amount.*

There yet remains one element in milk for consideration, namely, the so-called antiscorbutic element. What this substance is no man has yet discovered; we know, however, that it is present in all fresh animal or vegetable foods, and that it gradually disappears as the same food is kept or preserved for any length of time; the act of boiling or sterilisation seems to deprive milk of a certain proportion of the antiscorbutic element. Some authorities consider that the risks attendant on the use of boiled milk are so serious from the point of view of scurvy, that they prefer to run the gauntlet of tuberculosis and other infectious diseases, and leave the milk unboiled. *Since, however, scurvy in infants can not only be prevented, but actually cured by supplying a little fresh fruit juice, meat juice or mashed potato, the fear of scurvy is no argument against the employment of boiled milk.*

Let me now briefly recapitulate what I have already said with regard to the conditions which must be fulfilled by any artificial substitute for human milk, if this substitute is to give really

satisfactory results, immediate as well as remote. *It must contain all the elements necessary for the growth and maintenance of the body, that is to say, proteid food for building up the tissues, fats for maintaining the temperature, and carbohydrates for the supply of energy; salts there must also be for strengthening the bones, and an antiscorbutic element for the prevention of scurvy. These elements must be combined in the same, or approximately the same, proportions as they occur in human milk. They must be presented in such a form that they can be digested and absorbed, and, in addition, they must possess those physical characteristics which are essential for educating the stomach and digestive processes in their normal functions.*

Incidentally, I have explained how these conditions can be fulfilled by the dilution of cow's milk with water or barley water, with the addition of cream and sugar; you will find all the necessary details on page 108. I do not pretend that this is a perfect or an ideal method, but I think it is as good as circumstances permit.

So far I have said nothing about the quantity of the food that is to be supplied to an infant. This is naturally a very important matter. *The infant has to be taught to manage quantity as*

well as quality, but it should be no ambition of ours to teach a child to take large amounts—*we should teach it rather to extract the full value from a small quantity*. The less coal an engine consumes the more efficient is that engine regarded, and so it should be with babies in respect to their food ; a large appetite is chiefly a matter of habit, and a bad one at that, and it implies waste, extravagance and inefficiency. The actual quantities of food that should be supplied to a baby during the various periods of life, are clearly stated on page 100. You cannot do better than follow these, though I do not pretend that they are applicable in all cases, but it is quite safe to say that the less you depart from them, the better. You will doubtless find great difficulty in persuading mothers that they do not know a great deal more on the subject of quantity than you do yourselves, for nearly all artificially-fed infants among the lower classes are habitually overfed with food that is of indifferent quality, and, as I have already said, deficient in fat. They very rarely suffer from real starvation, for *healthy infants can thrive and be thoroughly well on the most marvellously small quantities of food, provided that it be good, and correctly modified*. Babies suffering from indigestion and dilated

stomachs are nearly always ravenously hungry, but this form of hunger can only be cured by judicious starvation.

Regular times of feeding, and moderate quantities at each feeding, are absolutely essential for the proper education of the stomach, for it has to be taught good habits, and it has to be taught to take proper rest, just as a child has to be taught to sleep properly, and give rest to the brain. Would you be surprised if a child became neurotic or even imbecile if its intellectual education was continued uninterruptedly throughout the twenty-four hours? I think not! Neither should you be astonished if a stomach that is given no rest becomes unruly and rebels. *The more delicate the child, the longer should be the intervals between the times of feeding,* for such a child digests more slowly, and with greater effort; consequently its gastric organ requires a longer time for recovery.

The huge infant mortality which the nation has yet to face is chiefly due to a want of appreciation of the principles which I have already enumerated. There are, it is true, many other factors at work, and to each of them I hope in due course to refer, but for the moment I would ask your attention to the important factor of *milk contamination.*

I think most of you will agree with me that if we elect to bring up a baby on modified cow's milk, no amount of manipulation, modification, artificial digestion or sterilization will ever convert a milk which is initially bad, into a milk which is even relatively good; a vast deal of the milk which is modified or humanized for infant consumption in London is undoubtedly initially bad, and especially is this the case during the summer months; and the deleterious changes which occur in it and render it unfit for use are practically always due to the growth of bacteria. These micro-organisms, unfortunately, will find their way into cow's milk; in fact, milk taken directly from the udder in the ordinary way invariably contains a considerable number of bacteria belonging to the group of streptococci. If the first portions of the fore-milk are thrown away, that which is subsequently obtained is either quite free from bacteria, or very nearly so. Tuberculous cows, or cows with tuberculous udders, usually supply milk infected with the bacillus of consumption. Bacteria find their way into milk at the time of milking otherwise than by means of contaminated udders. Dirt nearly always drops into the pail, and this dirt, if it consists of debris from the skin, or of hairs from the cow's body, or of excrement,

may introduce millions of bacteria, including the tubercle bacillus during the time of milking. According to experiments made by the Milk Commission of the Medical Society of the County of New York,* it was shown "that milk from four dirty cows, in a clean barn with clean milkers, gave an average of 90,000 bacteria to the cubic centimetre†; milk from four other cows of the same herd, carefully cleaned and milked by the same men, gave an average of only two thousand." This early contamination is supplemented by dust from the air, dirt in dairy utensils, and in many additional ways before it is delivered at the houses of the customers. In milk obtained from dairies in London the number of bacteria varies from about one million to eight millions per cubic centimetre. Under suitable conditions the rate or growth of bacteria in milk is so prodigious that, if nothing interfered with its tendency to multiplication, a single bacterium would produce about seventeen million at the end of twenty-four hours.

Seeing, then, that milk is always contaminated at the time of milking, and that a

* Report of the summer work of the milk commission of the Med. Soc. of the County of New York, U.S.A.

† One cubic centimetre represents about 17 minims or drops.

single bacterium can give birth to something like seventeen millions at the end of twenty-four hours under suitable conditions, the only reasonable means of preventing serious contamination is to consume the milk before the bacteria have had time to greatly multiply, or else to introduce some conditions unsuitable to their growth. As a matter of practice there are only three ways of doing so : (1) by adding some antiseptic to the milk, (2) by boiling, sterilizing or pasteurising the milk, (3) by keeping the milk at a low temperature. None of these methods are entirely satisfactory or free from objection. The antiseptic which hinders the growth of bacteria may have in a minor degree a similarly depressing influence on the vital processes of the infant. The heating of milk destroys its vital or antiscorbutic elements, and the effect of cold, though valuable in preventing the further growth of bacteria, is not to destroy those already present. This last is an important consideration when we remember that the germs of consumption, of scarlet-fever, of diphtheria, of typhoid, of epidemic diarrhœa, and many other diseases may be present in the milk.

Unsatisfactory, then, as all these devices undoubtedly are, the least of all the evils is, I think, that which is associated with the simple

boiling of milk. On this question of the boiling or non-boiling of milk, acrimonious discussions are apt to arise between partisans of one method or the other. I hope that all of you will take up a very judicial attitude on this subject. Those in favour of not boiling milk, say that boiling impairs its nutritive qualities—such people might well be asked what they mean by nutritive qualities. Although we should be careful to discriminate between digestion and nutrition, you will find that many people, when they talk about a food being nutritious, mean that it is digestible.

On the whole, boiled milk is more digestible than unboiled; on the score of nutrition, in the proper significance of the term, I can only tell you that in my experience boiled milk is quite nutritious enough for all ordinary purposes. The mere boiling of milk often fails in its intended purposes, for it only destroys fully developed bacteria, it does not destroy the spores; these spores or eggs, as we may for convenience regard them, soon hatch out under the genial influence of the warmth to which boiled milk is often exposed.

If milk is boiled and allowed to cool down slowly, the spores soon develop into full grown bacteria, and at the end of a few hours the milk is once again swarming with bacteria. If you

boil milk, therefore, cool it down as quickly as possible, and keep it on ice if you can; if not, keep it in cold water, and never for more than twelve hours, then the spores will have fewer opportunities of developing. The chief objection to the boiling of milk, an objection to which I have several times drawn attention, is the destruction of the antiscorbutic elements to which it leads. *This objection is overcome by the addition of some fresh food, such as fruit juice or meat juice, to the infant's dietary.*

Although so much time has been devoted to the subject of the artificial feeding of infants, this is not out of disrespect to nature's method, which is undoubtedly the simplest, the best, and the most economical of all methods.

The advantages of breast feeding over all other systems are indeed so universally recognised that I need not labour the point, except perhaps to mention one or two arguments in its favour which are not as a rule fully appreciated by the lay public. In the first place it should be borne in mind that there exists a distinct relationship or parallelism between the chemical constitution or quality of a mother's milk, and the food with which the fœtus is nourished during intra-uterine life, that is to say, the quality of a milk depends very largely on the quality of

the blood from which it has been elabo
when, therefore, a mother nurses her o
fant, there is a continuity in the method of feed-
ing, which is destroyed if immediately after
birth any artificial method of feeding is adopted.

This is a very important consideration, seeing that an infant at the time of birth experiences so many changes in its environment : the fewer and the less violent the changes, the better is it for the new-born child ; this argument tells almost as much against wet nursing as against artificial feeding, and, indeed, from a great number of points of view, these two methods of feeding, that is to say, maternal nursing and wet nursing, do not deserve to be classed together.

Another very important advantage possessed by maternal as opposed to cow's milk is that the former possesses a number of almost indefinable chemical bodies of the nature of ferments or antitoxins, which confer upon the infant the same kind of resistance to disease that the mother herself possesses. For instance, supposing that the mother has some natural immunity to tuberculosis, there can be no doubt that in some degree she imparts a similar kind of immunity to her infant if she suckles it herself. A very interesting example of the way in which this principle may be turned to practical

use, is instanced in the case of the treatment of exophthalmic goitre by administering to the patient the milk, or dried blood, of goats after the latter's thyroid glands have been artificially removed. A goat deprived of its thyroid gland has a blood condition which is in certain respects complementary to that which obtains in persons suffering from enlargement of the same gland or from exophthalmic goitre, and within limits its milk possesses properties antagonistic to the disease; at any rate, this is the rationale on which is based this modern method of treatment.

This interpretation helps to explain the common experience that breast-fed infants are less susceptible to disease than those who are artificially reared. Cows and other animals, whose milk we consume, do not under natural conditions contain either in their blood or in their secretions substances which have an antagonistic action to, or confer immunity against, many of the diseases from which human beings suffer.

Another natural advantage possessed by human milk is that it contains a large proportion of a substance called lecithin. Lecithin, apparently, is a necessary material for the building up of nerve cells and nerve structures, and inasmuch as the nervous system is more highly

developed in man than in the lower animals, it is clear that the human infant requires more of the food elements out of which nervous tissue is built up than do the young of other animals. Therefore, from this point of view alone, human milk has a very distinct advantage over ordinary cow's milk which is generally diluted.

From the educational standpoint, human milk possesses advantages which are not present in other varieties, for, concurrently with the development of the stomach, a mother's milk undergoes certain progressive modifications which most happily fit it as a medium for education. The variety of milk which is first secreted by the mammary glands, after they have become functionally active, is known as colostrum. Now colostrum differs in many essentials from ordinary milk; into the exact nature of these differences we need not enquire, it will be quite sufficient for my purpose if you understand that colostrum is more easily digested than milk, and that it acts as a less violent stimulus to the infant's stomach. The transition from colostrum to milk is slow and progressive, and it is generally extended over a period of several days, a time sufficient in most cases for the early education of the infant's gastric functions. From this time forward the character of the milk remains

more or less uniform, so that as I have already mentioned (page 62), human milk in the later stages of nursing fails to provide new means of education.

If a wet nurse is employed the educational advantage possessed by colostrum is lost unless it so happens that her baby was born at the same time as her foster child.

I have spoken elsewhere of the enormous importance of adhering to regular hours of feeding both in breast and in artificial feeding ; the number of feeds which should be given in the 24 hours, are clearly stated on page 122.

The quantity of milk that should be consumed by an infant at each feeding is of equal importance, but a matter which is far more difficult to control with any degree of precision. *In breast feeding the actual time occupied in completing a feed is no guide whatsoever as to the amount consumed*, for some infants, owing to deficient powers of suction, or to defects in the formation of the nipples or to limited powers of secretion on the part of the breasts, may become physically tired before they are nutritionally satisfied. The difference in the size of the breast or breasts before and after suckling is a far better guide, and the number and size of the infant's stools, or the quantity of urine

passed, during the 24 hours affords additional information on the same subject. Then, again, vomiting or regurgitation of food at the completion of a meal is strongly presumptive evidence that the stomach has been over-loaded. *The only accurate way, however, of estimating the amount taken is to weigh the infant before and after a test meal.* For this purpose accurate scales are necessary, that is to say, scales that will weigh to half an ounce or less. In a case of doubt, I advise you to send the mother and the infant to a Welfare Centre and ask that a "test" feed may be given and see how much milk is actually consumed. Some infants who have had the reputation of being starved, and who have been supplied with additional feedings out of a bottle to supplement the suspected deficiency in the maternal supply, have been weighed in this way and found to be taking outrageously large quantities of milk at each breast-feeding. And in this connection I cannot too strongly emphasize that *no reliance whatsoever can be placed on the infant's own feelings in the matter.* When a mother says her baby is never satisfied, in nine cases out of ten this is due to indigestion or to a dilated stomach, and not to actual deficiency in the supply, and the symptoms are naturally only aggravated by increas-

ing the amount. A rule that seems very generally followed in breast feeding is to allow the infant to continue sucking until he " drops off," owing to the fact that he can contain no more. This is the way to over-develop the stomach: the stimulus for over-development is distension or over-distension; always stop short of this point, and *never allow regurgitation at the end of a meal.*

Under normal conditions the size of a baby's stomach is extremely small; the average capacity at birth is only slightly over 1 ounce, that is to say, two tablespoonfuls; at the third week $1\frac{1}{2}$ ounces; at the fourth week 2 ounces. I have known instances of " unsatisfied " infants being given 7 ounces of food out of a bottle at the fifth week—and the same sort of thing, though possibly in a less pronounced degree, occasionally occurs in breast feeding. In institutions abroad, where systematic methods of breast feeding have been employed, it has been repeatedly found by actual experiment that nursing mothers can sometimes suckle one or more infants in addition to their own; indeed, on one occasion it was found that an inmate of one of these institutions secreted daily an average of 106 ozs., or nearly $5\frac{1}{2}$ pints of milk, an amount sufficient to supply the needs of five

infants at the second month. From my own personal observation I am perfectly certain that among the upper classes more breast-fed infants suffer from excess of feeding than from a deficient supply, though undoubtedly a still larger number suffer from the fact that the milk is of bad quality.

Lactation is far more likely to "go wrong" in a woman than in the teetotal, vegetarian, nerveless cow. If the quality of the milk is to be constant, all the circumstances in the environment of the nursing woman must be constant also. This is an impossible ideal in modern civilisation. For not only do variations in diet, and a thousand and one other variations in a woman's life, affect the condition of her blood and consequently of her milk, but, most important of all, variations in her moods and mental condition have the most remarkable influence on the character of the mammary secretion; these variations cannot be estimated by chemical analysis, they can only be estimated by the effect upon the child; there is a well-known instance on record of sudden death carrying off a baby which, although previously in perfect health, sank dead on its mother's bosom immediately after a meal. Previously to suckling her infant the mother had experienced

a terrible mental shock occasioned by a fight between her husband and a soldier who happened to be billeted in the house. The mother, trembling with fear and terror, threw herself furiously between the combatants, wrested a sword from the soldier's hand, broke it in pieces and threw it away. Following on this violent excitement the mother nursed her infant, with the result recorded.

It would be quite easy to multiply instances in which maternal milk has been known to have had the most serious effects, as the result of powerful excitement, mental shock or emotion; but I only mention the fact to indicate how important it is that women who are subject to fits of temper, epilepsy, attacks of migraine, and other spasmodic neuroses of the same kind, should not attempt to suckle their infants.

The mere fact that the maternal secretion is scanty is no adequate reason for giving up nursing altogether; in such cases it is far better to supplement the natural supply with a few additional feedings of artificial food. When mixed feeding of this kind is employed, the artificial food should be adjusted in quantity and quality to the age and requirements of the infant, in accordance with the instructions given on page 97. Such feelings should alternate as far as

possible with the breast feedings. There is absolutely no reason for supposing that the two kinds of milk will disagree, although it is quite possible that if the cow's milk is not properly adjusted to the digestive capabilities of the child, some evidence of its unsuitability may be manifested.

The time at which an infant should be weaned is of distinct importance, for no woman can continue indefinitely to secrete a milk of good quality. Many women among the poorer classes continue to suckle in the hope that a subsequent pregnancy may be averted or delayed; there appears little ground for such a belief. No infant should subsist exclusively on breast-milk for more than nine months. Indeed, it is advisable in the majority of cases to introduce a bottle of artificial food at the sixth month, in order to prepare the infant for the subsequent change; the time at which the bottle should be given should be so arranged as to coincide with the delivery of the milk at the house, that is to say, while it is still fresh. But in no case should the transition from the breast to the bottle be sudden. There should be a gradual increase in the number of the daily bottles, and a gradual increase in the strength of the milk.

CHAPTER IV.

THE FEEDING OF INFANTS : CERTAIN PRACTICAL DETAILS.

In order that a food may fulfil all the physiological requirements of the infant it must comply with the following conditions : —

1. The quantity as estimated in caloric values must correspond to the estimated requirements.

2. The "balance" or proportion of the main constituent elements must be based on the physiological requirements.

3. Not only must the food be presented in a form adapted to the existing digestive capacities of the infant, but also it must make provision for their physiological development.

4. The intervals between feeds must be regular and sufficiently spaced to allow of the complete emptying of the stomach.

5. The food must be clean and free from bacterial and other contaminations.

Each of these points must be considered in detail.

THE QUANTITY.

No two infants, even though they be of the same age and weight, will necessarily require exactly the same amount of food; the amount in any particular case will depend on the following conditions:—

1. The amount of mechanical work performed, *i.e.*, on the exercise taken.

2. The amount of heat required to maintain the temperature of the body.

3. The rate of growth and the requirements for repair.

4. The quantity of secretions elaborated.

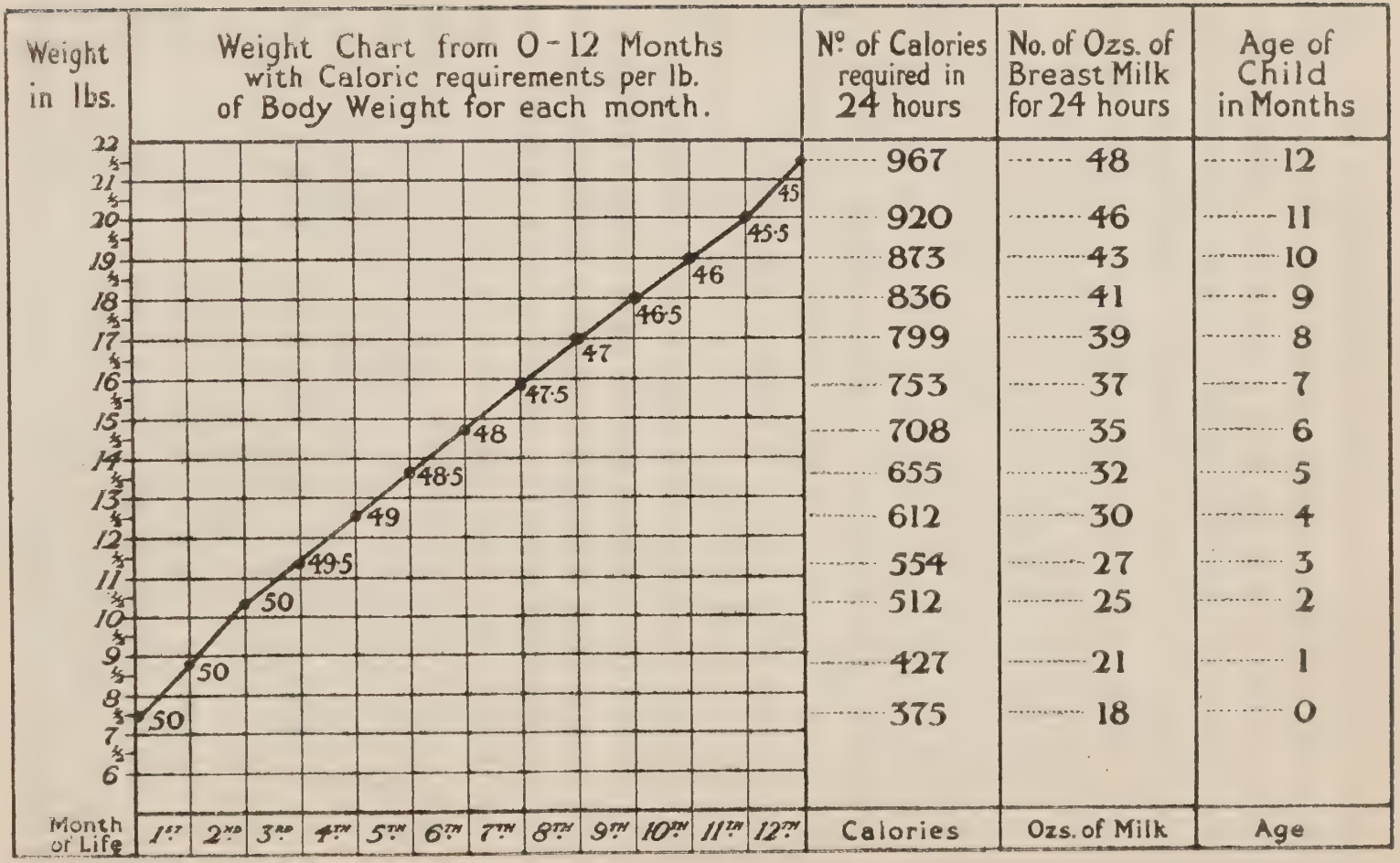
The amount of food is therefore variable and dependent on circumstances; but within comparatively narrow limits certain approximate averages can be relied upon to hold good in the majority of cases. These averages are based chiefly on the weight of the infant, for within limits the larger the child the greater will be the loss of heat, the greater also its output of work, and its requirements for growth. At the same

time the age of the child must be taken into consideration, for two infants of the same weight, but one, let us say, three months old and the other nine months old, will as a rule not be equally active ; the latter will probably be far more active muscularly than the former, and will therefore require a correspondingly larger quantity of food, in spite of similarity in size.

All estimations of quantity are calculated on a basis of caloric values. An infant under six months of age requires food of the value of about 50 calories for every pound of body weight, whereas an infant above six months of age requires food of the caloric value of about 45 calories for each pound of body weight. As the infant grows older there is a gradual fall in the number of calories required per pound of body weight ; there is no sudden fall at the sixth month. In the accompanying table I have indicated the character of the gradual fall from birth onwards. In this table it will be observed that at five months the caloric requirements are 48.5 calories per pound weight, and at nine months 46.5 calories, and so on for the intervening months. To take an example : if, in accordance with the figures on this chart the caloric requirements of an infant four months old are 49 calories per pound weight, and if the

average weight of an infant at this age is $12\frac{1}{2}$ lbs., the total caloric requirements for the 24 hours will be $12\frac{1}{2} \times 49$, or 612 calories. If the total requirements of such an infant are 612 calories, how much breast-milk, or its equivalent, must an infant consume to obtain the necessary value? Now the caloric value of breast-milk is between 20 and 23 calories per ounce, according to its degree of richness, particularly in respect to its cream content. If, for the sake of argument, we assume that the milk is a rich one, affording 23 calories per ounce, the total milk requirements for the 24 hours will be $612 \div 23$, or $26\frac{1}{2}$ ozs. Similarly the caloric requirements and the corresponding amount of milk can be calculated for infants of all ages and weights.

A chart of this kind serves as a valuable guide for the estimation of quantities, but it must not be followed too slavishly, for in each particular case there are probably special circumstances which will modify the actual as compared to the theoretical requirements; for instance, very active babies, viz., those who use their legs and arms freely or sit up and crawl at an early date will require more food than the average estimates, while large, fat lethargic babies will require less than they are entitled to on the estimate of their weight. Further, in cold weather


Weight in lbs.
Weight Chart from 0 - 12 Months with Caloric requirements per lb. of Body Weight for each month.
22
21½
21
20½
20
19½
19
18½
18
17½
17
16½
16
15½
15
14½
14
13½
13
12½
12
11½
11
10½
10
9½
9
8½
8
7½
7
6½
6
50
50
50
49·5
49
48·5
48
47·5
47
46·5
46
45·5
45
Month of Life
1st
2nd
3rd
4th
5th
6th
7th
8th
9th
10th
11th
12th
Nº of Calories required in 24 hours
967
920
873
836
799
753
708
655
612
554
512
427
375
Calories
No. of Ozs. of Breast Milk for 24 hours
48
46
43
41
39
37
35
32
30
27
25
21
18
Ozs. of Milk
Age of Child in Months
12
11
10
9
8
7
6
5
4
3
2
1
0
Age

more food will be required than in hot weather, while infants with many clothes and whose dissipation of heat is consequently restricted, will require less food than those who are thinly clad. The figures as estimated in the chart serve as an excellent basis and will prevent serious errors being made.

It may be objected that these figures only refer to breast-fed infants, and that the amount of food consumed by nurslings cannot be estimated. As a matter of fact, by weighing the baby on accurate scales before and after feeding, the exact amount of food consumed can be measured, and this precaution should always be taken not only to ensure that the infant may obtain his full allowance in the 24 hours, but also to ensure that he is not over-fed at some feeds and under-fed at others. Nothing is better calculated to upset the temper of an infant than irregular feeding of this kind.

The estimation of the caloric value of artificial substitutes for breast milk is extremely easy if all such substitutes are made up to breast standard, that is to say, if they contain the same relative proportions of proteins, fats and carbohydrates and in the same percentage as in breast milk. All such foods will then have a caloric value of 23 calories for each ounce.

In certain cases artificial substitutes for breast milk may, for definite reasons, be modified to a different standard; they may, for instance, contain less fat or more sugar, and to supply the necessary details for calculating the caloric values of such mixtures, the values of some of the more common foods are supplied in the following table:—

The caloric value of—	Calories per oz.
Cow's milk is	20—23
Breast milk	20—23
Cow's milk modified to breast standard	20—23
Sugar	116
Starch	116
Proteid	116
Fat	236
Cream (46 % fat)	120
Cream (20 % fat)	55
Flour	103
Patent Foods	100—140
Dried milk (full cream) ...	160
Dried milk (half cream) ...	140
Condensed milk (sweetened) ...	90—100

By reference to the above or to some more

complete tables*, it is possible to avoid the serious mistakes which are constantly made with reference to the quantity of artificial foods given to infants. If we wish to know, for instance, how much of any particular food should be given to a baby four months old, the calculation can be made in the following manner: On reference to Table p. 100 we see that the caloric requirements of a child of this age are 612 calories for the 24 hours; from this it is again easy to estimate how much condensed milk, dried milk or other substitute food, must be given in order to supply the required number of calories.

If condensed milk, which has a caloric value of 100 per ounce, is used, the total quantity that must be given in the 24 hours will be 6 oz. approximately. If dried milk is used, about $3\frac{1}{2}$ oz. must be given, or if a patent food is used the required quantity will be about 5 oz.

The actual quantity of any of these foods to be given at a single feed will naturally depend on the number of feeds given in the 24 hours. If there are six feeds in the 24 hours, the amount at each meal will be one-sixth of the total for 24

* Margaret McKillop's Food Values—*George Routledge & Sons.*

hours. In the case of condensed milk, this would mean that one ounce would be needed for each feed. When this quantity is compared to that which is usually given to an infant four months old, it will be realized how very easy it is to make serious mistakes unless quantities are estimated on a basis of calories. I feel sure I am not exaggerating when I say that the average baby four months old who is fed on condensed milk rarely gets more than four teaspoonfuls, which is 50 per cent. below the average physiological requirements.

A food, however, may be given quite correctly as regards quantity and yet be most unsuitable if the " balance " or qualitative " make up " is not adapted to the physiological requirements.

THE " BALANCE " OR QUALITATIVE MAKE UP.

On general principles it may be assumed that breast milk is of correct balance for the human baby, for otherwise it is impossible to understand how the thousands of generations of babies who have depended on breast milk as their sole food for the first year of life could have survived. The same is also true in the case of the

milks of other species of mammals. The milk of each may be assumed to be of the correct balance for the respective young. The milk in each case is of a different balance because the requirements of the young of different mammals vary very considerably: some require a larger amount of protein than others, some require more sugar and fat, others require less, according to their rates of growth, habits and environmental conditions.

Without suggesting that too sweeping deductions should be drawn from the facts, it may be stated in general terms that the young of those animals which develop quickly require a large amount of proteid food, and that those which are exposed to great external cold should be provided with a larger proportion of fat; further, that those young animals which are specially active should be provided with an ample quantity of sugar. If the following tables are examined from this point of view it will be observed how closely these physiological principles are adhered to.

TABLE.

Mammals.	Number of days in which the newly born animal doubles its weight.	Percentage content of Protein in Milk.
Infant	180 days	1½
Foal	60 ,,	2
Calf	47 ,,	3½
Young Goat	22 ,,	3¾
Lamb	15 ,,	5
Pig	14 ,,	5¼
Kitten	9½ ,,	7
Puppy	9 ,,	7½
Young Rabbit	6 ,,	10½

Animal.	Percentage of Proteins.	Percentage of Fat.	Percentage of Sugar.	Percentage of Salts.
Man	1·6	3·4	6·1	0·2
Dog	7·3	11·9	3·2	1·3
Mare	2·0	1·2	5·7	0·4
Ass	2·2	1·6	6·0	0·5
Cow	3·5	3·7	4·9	0·7
Reindeer ...	10·4	17·1	2·8	1·5
Dolphin ...	17·6	43·8	...	0·5

In consideration of the above facts, it may be assumed that if human milk is replaced by an artificial substitute, the latter should conform as accurately as possible to the balance of the former, at least as far as the three main constituents, viz., proteins, fats and sugars, are con-

cerned. Any deviation from this standard will on theoretical grounds adversely affect the nutrition of the baby. Infants fed on artificial foods, in which the standard noticeably departs from that of breast milk, as, for instance, in the case of unmodified cow's milk, condensed milk or dried milk, never thrive as satisfactorily as they might do were these foods modified to breast standard. The reason why patent foods are as popular as they are is because the infants who consume them are in many cases comparatively healthy; they may, indeed, present no serious symptoms of mal-nutrition, but, all the same, in some respect or other they fall far short of perfection. They may be too fat, they may have over-developed stomachs, they may be unresistant to infective diseases, or they may suffer in many other ways from mild disturbances of metabolism.

For this reason, no matter what be the particular variety of food—be it cow's milk, dried milk or condensed milk—it should, in all cases and without exception, be modified to the standard which the history of the race and contemporary experience has proved to be best adapted to the physiological requirements of the developing infant; in other words, to the standard of breast milk.

The balance of the three chief elements in cow's milk is as follows :—

Proteins 4 %, fat 3.5 %, sugar 4 % ;

while that of breast milk is :—

Proteins 1.5—2 %, fat 3.5 %, sugar 7 %.

It will be observed how widely the two standards differ ; cow's milk, however, can be readily modified with respect to these constituents to the standard of breast milk by dilution with water and the addition of cream and sugar. The following formula indicates how one pint of cow's milk modified to breast standard may be prepared :—

Take of—

Cow's milk	10 oz.
Thick cream (45—50 % fat)	1 oz.
Sugar	1 oz.

Water to make a total of 1 pint.

This modification can be very easily carried out provided that cream is available ; if the latter cannot be obtained certain cheaper substitutes may be employed ; for instance, 50 per cent. emulsions of such oils as linseed oil, nut oil, olive oil, cod liver oil, or other available varieties. Some of these substitutes for cream are sold commercially under the name of Marylebone cream.

There are other ways of modifying cow's milk to the standard of breast milk, as, for instance, by employing the so-called "Top Milk" method or by using whey in combination with milk, but none of them, in my opinion, give appreciably better results, and most of them involve more complicated procedures.

THE MODIFICATION OF DRIED MILK TO BREAST STANDARD.

It is a strange commentary on the intelligence of many of those who are responsible for the management of certain Welfare Centres that when dried milk is prescribed for the infants who attend at them, it is exempted from the same kind of modification to breast standard that is carefully enjoined in the case of dairy milk. If it is necessary to modify cow's milk to this standard, it certainly must be necessary to modify dried milk. I feel convinced that the failures connected with the use of dried milk in infant feeding are due to this want of modification, and not to any inherent defects in the desiccated milk itself. I have myself employed dried milks for the purposes of infant feeding for the last 16 years with as good, or possibly better, results than when I have used "so-called" fresh milk, but I have

always taken the precaution of modifying to breast standard and supplying any accessory food factor which may be wanting or deteriorated in the process of drying the milk.

The method of modifying dried milk to breast standard is just as simple as that of modifying dairy milk, for dried milk is approximately eight times as strong as wet milk, hence any formula for modifying dairy milk to breast milk or any other standard can be employed for the modification of dried milk provided that one drachm of dried milk is substituted for each ounce of wet milk. Referring to the formula for modifying cow's milk given on page 108, and substituting ten drachms or teaspoonfuls of dried milk for the ten ounces of dairy milk which are required to be employed in the preparation of a pint of mixture, we arrive at the following formula :—

Take of—

Dried milk	10 drms. or $1\frac{1}{4}$ oz.
Cream (45-50 % fat) ...	1 oz.
Sugar	1 oz.
Water to make a total of	1 pt.

It must be remembered that at least one kind of dried milk which is on the market is not merely milk from which the water has been

evaporated by heat, but that it represents a combination of dried milk and sugar, a combination which when mixed with water without further modification, is supposed to provide a mixture in which the "balance" is correct. There are risks in using such dried milks because they are not exactly what they are represented to be. In selecting a dried milk it is safer to employ one that has not been manipulated in any other way than having been subjected to heat.

THE USE OF CONDENSED MILK.

Very grave injustices are often inflicted on infants by the long continued and indiscriminate use of condensed milks—injustices which are connected not only with caloric value, but also with "balance" and accessory factors. The question of quantity was referred to on page 103; with respect to "balance" it must be remembered that the average percentage composition of the ordinary sweetened varieties is as follows:—

Protein 9.7 %, fat 10.13 %, sugar 50.53 %. An examination of this percentage composition readily explains that no degree of dilution with water can provide a mixture with a "balance" in the least degree comparable to that of breast

milk ; for instance, if it be diluted in the proportion of one teaspoonful of condensed milk to one ounce of water, the resulting mixture will be one-eighth as weak as the original condensed milk ; in other words, its " balance " will be : —

Protein 1.2 %, fat 1.2 %, sugar 6 %.

Such a " balance " is obviously defective in that the protein is too low and the fat even more so. There can be little doubt that infants in whom the digestive processes have been disturbed improve for a time on condensed milk dilutions, but they suffer in various ways if this method of feeding is continued for any length of time. One of the most serious results is that such children show very little resistance to infective disease, a result which in my opinion is due both to the deficiency of protein and to the deficiency in fat, quite apart from any defects it may possess in connection with accessory factors.

The defects which have been pointed out in connection with sweetened varieties of condensed milk do not apply to the unsweetened varieties. Unsweetened condensed milk can be modified to breast standard in exactly the same way as has already been described for the modification of dried milk, the only difference being that in condensed milk part of the water has

been removed by evaporation, whereas in dried milk all has been removed. Dried milk is eight times stronger than cow's milk, while unsweetened condensed milk is only five times stronger. Hence to modify unsweetened condensed milk the formula given for the modification of dairy milk on page 108 may again be used if one ounce of condensed is substituted for five ounces of dairy milk ; the formula will then run as follows : —

Take of—

Unsweetened condensed milk ...	2 oz.
Cream (45-50 % fat)	1 oz.
Sugar	1 oz.
Water to make a total of 1 pt.	

ACCESSORY FOOD FACTORS.

In considering matters of "balance" it is usual only to regard the relative proportions of proteins, fats and carbohydrates, without taking into account any of the other necessary constituents of a complete and physiological dietary. As a matter of fact, there are a number of additional elements which are absolutely essential and without which good nutrition is impossible, even though the three main constituents are apportioned absolutely correctly.

The more important of these accessory factors are :—

1. The so-called vitamines.
2. Certain lecithin bodies.
3. Salts.
4. A number of indefinite bodies, among which may be mentioned cholesterol, extractives, etc.

A few words in explanation of these factors may be offered.

Vitamines.—For want of space it is not possible to give here an adequate account of these mysterious bodies. So far their chemical constitution has not been determined, nor have they been separated in a pure form. The three main classes which are of significance in the feeding of infants are as follows :—

1. The anti-scorbutic vitamines.
2. The anti-neuritic vitamines.
3. The fat soluble vitamines which are essential for growth.

If an infant is deprived of any of these factors there is a failure of nutrition, and finally he becomes seriously ill. They appear to have a qualitative rather than a quantitative importance, and although so far they have defied measurement, it is known that very small quantities are sufficient to maintain nutrition.

The vitamines belonging to the first group are present in fresh milk, fresh vegetable and fruit juices. They appear to lose efficiency on keeping or on exposure to heat or to the action of alkalies. Infants who are fed on boiled, sterilized or dried milks, without the independent administration of fruit juice or other vitamine-containing substances, are liable to develop infantile scurvy, a disease which is similar to or closely allied to the ordinary scurvy which afflicts adults. It takes the form of spongy gums, sub-periosteal and other hæmorrhages. The disease is rapidly cured by the administration of fruit or vegetable juices.

The anti-neuritic vitamines are not present in fresh milk to any large extent, nor do they appear to be largely required for the maintenance of sound nutrition except in those cases in which considerable quantities of starchy or cereal food is consumed. Certain well-recognised diseases of a nervous character develop when the diet consists of too carefully refined cereal flours. It appears that the anti-neuritic vitamine adheres closely to the germ in wheat and other varieties of grain, and that this germ runs a risk of being removed in the process of refining or milling. Infants who are fed on patent foods which consist mainly of carbo-

hydrate material of cereal origin, especially when it is given in excess, are liable to develop a form of mild poly-neuritis which is characterised by considerable tenderness, paresis of muscle, and œdema.

The so-called fat-soluble vitamine is present for the most part in fats of animal origin, especially in cream, butter-fat, suet and cod liver oil. It is either absent from or only present in small amount in vegetable oils; nut oil appears to be an exception. Infants deprived of this accessory factor develop slowly and after a time cease to put on weight; their health immediately improves when this vitamine is given in some independent form. Grown animals appear to derive this important body from vegetable sources, *i.e.*, from green grass or leaves. When fed on dry fodder their fat contains a reduced quantity of it, hence the milk of cows who are stall-fed—especially in the winter—is apt to be deficient in this essential element, and naturally the same is true in the case of human milk when an inadequate amount of green food is consumed. The infant who is for obvious reasons unable to obtain this vitamine from vegetable sources is entirely dependent on an adequate supply in the milk.

Very unfortunately, in my opinion, this vita-

mine has been labelled " the anti-rachitic vitamine," giving the erroneous impression that *the* cause of rickets is want of this element in the food; the truth being that infants become ill and finally develop rickets if they are deprived of this element, just as they do from many other defects in their diet or hygienic management. Although cod liver oil may cure the form of rickets which is due to want of this fat-soluble vitamine, it will not influence rickets due to some entirely independent cause.

LECITHIN BODIES.

These substances exercise an important though little understood influence on nutrition. They are present in cow's milk in about the same proportion as in breast milk; if, therefore, they are quantitatively adjusted in these secretions to the physiological needs of the developing animal, there is clearly a risk of a defective supply if diluted cow's milk forms the basis of the diet. It is quite easy to supply lecithin independently of the milk; it can be given as a pharmaceutical preparation, or in its natural state in the yolk of egg. Lecithin may be conveniently prescribed in the form of elixir lecithin. A teaspoonful daily added to the milk is probably sufficient.

SALTS, EXTRACTIVES, ETC.

There is always present in milk a variety of salts in organic combination besides a large quantity in inorganic combination. Although it seems reasonable to suppose that the major portion of the inorganic salts are decomposed by the free hydrochloric acid in the stomach and thus reduced to the inorganic state, none the less from the point of view of nutrition the organic salts appear to possess certain advantages. The total quantity of salts in cow's milk is something like three times as much as in breast milk; so that irrespective of the exact nature of the combination, the actual quantity of salts in diluted cow's milk may be assumed to be sufficient, and the same of course applies to dilutions of condensed and dried milks.

Very little is known with regard to the extractives present in milk; it is probable, however, that there are differences with respect to those present in cow's milk and breast milk. I have found the administration of a few ounces of broth made from bones and vegetables of undoubted advantage in artificial feeding with milk dilutions. I believe that this is partly due to the stimulating action of the extractives, and partly to the organic salts of vegetable origin.

It is almost certain that breast milk contains a

small quantity of the protective bodies elaborated by the tissues of the mother, and hence breast milk may confer some degree of natural immunity on the infant with respect to those germs to which the mother is herself immune, hence a possible explanation of the greater resistance shown by breast-fed infants to the infective diseases.

THE DIGESTIBILITY OF THE FOOD.

No matter how accurately the caloric value and "balance" of the infant's food may be adjusted to the physiological requirements, the baby will not thrive unless the condition of digestibility is also fulfilled. Young infants in whom the digestive functions are but feebly developed, are often allowed to lapse into a condition of semi-starvation because they are unable to digest particular varieties of food adjusted correctly as regards quantity and "balance." This is quite unnecessary and a great injustice to the infant; there is no reason why an infant should be starved because he is temporarily unable to digest the food which is necessary for nutritional purposes. It surely is more reasonable to supply an infant with food of the required amount as measured in calories and of the physiological "balance," and to ad-

minister it in a form adapted to the feeble digestive powers of the infant. If an infant is unable to carry on his digestive functions it is surely better to help him to do so by artificial expedients, than to allow all his nutritional processes to languish from starvation. The predigestion of food is quite a simple matter ; it may be carried out by means of Liquor Pancreaticus, Fairchild's peptonizing powders, or by many other artificial digestants. The chief mistake which is usually made is that of insufficient predigestion. Under natural conditions the total time occupied in the digestion of cow's milk in the intestinal tract of the baby is about six hours ; it is hardly reasonable to suppose that the same food can be pre-digested in a jug in a shorter time. In the practical carrying-out of the pre-digestion of milk dilutions the time taken should not be much less than three hours ; as the infant's digestive powers develop, the time of peptonization may be gradually reduced. Newborn babies should have their food very thoroughly digested, say for about three hours, and with each succeeding day the time may be reduced by ten minutes or more. It is sometimes objected that milk peptonized for this time becomes too bitter for consumption ; I have not found this verified in actual practice, for the

younger the infant the less need questions of taste be taken into consideration.

The education of the infant's digestive functions does not end with teaching him to digest ordinary dilutions of cow's milk. He has to learn how to digest other varieties of carbohydrates besides milk sugar; for instance, cane sugar, malt sugar, and starch. He very readily learns to do this if small quantities of any of them are substituted for the milk sugar, and if the quantity is slowly increased as experience is gained. In my opinion, infants benefit by having small quantities of weak cereal decoctions from about the third month onwards. Infants thus educated are in a position to digest rusks or other solid varieties of starch by the time the teeth are sufficiently advanced to carry out the functions of mastication.

TIMES OF FEEDING.

An infant's food, although correct as regards quantity, "balance," and digestibility, may prove unsatisfactory if it is given at unsuitable intervals. It is essential not only that the food should be given at regular intervals, but also that these intervals should be sufficiently "spaced out" to give the stomach time to become emptied and to recover from fatigue. As

a general rule it takes longer for the stomach to empty when cow's milk is employed than with breast feeding, and weakly and debilitated infants take longer to digest the food properly. Practical experience proves that the old-fashioned two-hourly feeding gives the stomach far too short a period of rest, so that vomiting and other symptoms of indigestion are liable to result. On the whole it will be found that a larger number of infants do better with three-hourly feedings than with other intervals. The best hours are 6 a.m., 9 a.m., 12 m., 3 p.m., 6 p.m., and 9 p.m. In accordance with this plan a long interval for rest is ensured during the night. This is of incalculable advantage to the infant, but in order that these ideal times of feeding may become habitual it is necessary that they should be instituted the first day of life when such functional habits are most easily established.

THE PURITY OF THE FOOD.

An infant's food may be perfectly correct as regards quantity, "balance," digestibility and intervals, but none the less if it contains poisonous material or pathogenic germs the health of the child will be in danger. As a rule breast milk is relatively sterile, or if con-

taminated with germs the latter are of a comparatively harmless character. In the case of artificial feeding, the case is quite different. The danger to the infant of bacterial infection is, in the latter case, considerable, not only from the accidental contamination of the milk with the germs of such recognised diseases as tuberculosis, diphtheria, typhoid and scarlet fever, but also from a number of septic, putrefactive and fermentative bacteria which may excite inflammatory reactions in the infant. For the most part the dangers of food infection can be avoided by the sterilization of the food. Unfortunately prejudices exist against the boiling of milk on the ground that the nutritional properties of the milk are thereby depreciated. As a matter of fact, the only damage that heat can inflict on milk is associated with the destruction, or partial destruction, of one of the accessory factors, viz., the anti-scorbutic vitamine. This is, however, no argument against a procedure which confers such obvious advantages in other directions. Consequently I very strongly advise the sterilization of any substitute for breast milk, and the independent administration of orange juice to compensate for the destruction of the anti-scorbutic vitamine.

THE PROCESS OF STERILIZATION.

If milk or other substitute food is brought to the boil, all the ordinary pathological bacteria are destroyed; the only germs liable to survive are the spores of bacteria which excite decomposition of the food. The latter are, however, so greatly reduced in numbers by the process of boiling that this method of sterilization may be safely relied upon if the milk is consumed within a reasonable period after heating. Such milk if kept for a few days is apt to go bad and become a source of danger. The mere boiling of milk will not, however, protect it from subsequent contamination; to ensure the purity of the milk it is wise to make use of the Soxhlett or other sterilizing apparatus, in which the required number of feeds for the 24 hours are poured into the required number of bottles with automatically sealing indiarubber caps. By the use of this apparatus each feed is adequately sterilized and protected from further contamination up to the moment of feeding.

To sum up quite shortly the conditions for correct feeding outlined in this chapter, it may be repeated that, firstly, the quantity of the food must be adjusted to the physiological requirements; in other words, its caloric value must be adjusted to the age, weight and general require-

ments of the infant. The "balance" or relative proportions of the three main constituents, *i.e.*, the proteins, fats, and carbohydrates, must be based on the standard of breast milk, while all the accessory factors must be adequately represented; the food must be adjusted to the digestive capacities of the infant and designed to develop those in process of evolution. Further, the food must be supplied at sufficiently long intervals, and must contain no bacteria or other impurities.

CHAPTER V.

PRINCIPLES AND DETAILS OF FEEDING AT AND AFTER WEANING.

THE subject of this chapter is the feeding of the infant during the transition period, *i.e.*, between the period when only milk is consumed and when the infant begins to take solid food. At the present time the subject of the feeding of the infant proper, that is to say, up to the time of weaning, is well understood, but from that time onward many mistakes are made.

I propose to deal more particularly with the principles on which the system of feeding at these stages should be based; I shall consider, later on, some of the practical details, but it is the guiding principles to which I shall chiefly refer. The transition from the milk stage to the solid food stage is beset with all manner of difficulties.

I have made a careful study of dietaries recommended from weaning onwards, and I find that many of them violate both the principles which apply before this period, and also those which apply again to the diet of older in-

dividuals. Is there, then, some special condition existing at this particular age to justify this? The transition period is undoubtedly a difficult one, involving a change from a liquid to a solid diet, but there appears to me to be no necessity to throw considerations of food values and balance to the winds.

BASIC PRINCIPLES IN REGARD TO QUANTITY.

There are certain principles which must be obeyed in order that compliance may be made with the physiological conditions.

First, as regards quantity. This depends on four conditions:—

(1) The amount of material required for growth and for repair.

(2) The amount of fuel required to afford heat for the maintenance of body temperature.

(3) The amount of food required for energy production or work.

(4) The amount of food required to manufacture lubricating and other secretions.

No two individuals require exactly the same total, and no single individual will show the same requirements from day to day, from week to week, or from year to year, so that no hard and fast rule can be laid down with regard to

precise quantities; this must be subject to change in accordance with the necessities of the hour. Standard dietaries can be drawn up, but they must be used with care; if they are slavishly followed they will never be exactly right. They must be our servants and not our masters. If quantity, then, is of real importance, it is also important to have the means of measuring quantity. There is only one practical way of securing this end, and that is to rely on caloric values. If we know how many calories certain foods supply, and how many calories are required by the individual in the twenty-four hours, it is easy to decide how much of these particular foods must be consumed in order to afford the required number of calories. Tables have been drawn up which give these particulars.

IMPORTANCE OF CALORIC VALUE.

For instance, a baby of average weight (about 11 lb.) at three months needs about 560 calories (50 calories per pound of body weight). (See page 97.) If the caloric value of breast milk is 23 per ounce—a liberal estimate—such an infant will require 560 divided by 23; that is to say, 25 ounces of breast milk in the twenty-four hours.

At six months old a baby will require 708 calories, and hence 35 ounces; at nine months, 836 calories or 41 ounces; at one year, 967 calories or 48 ounces. These estimations are easy when we are dealing with a milk of known caloric value, but difficult as soon as we come to consider a mixed diet, containing solid food in addition to milk. In spite of these difficulties, however, the principle still holds good that the food should be adjusted according to caloric requirements.

The caloric value of bread represents 76 calories per ounce, *i.e.*, more than three times as much as that of milk, when, therefore, bread is introduced into the diet we should reduce the quantity of milk in the same ratio, *i.e.*, about three ounces of milk for every ounce of bread supplied. There is no way of avoiding these adjustments if accuracy is to be maintained. If cognisance had been taken of this principle in many of the loose and incorrect dietaries at present in use, much trouble would have been avoided.

VARIATIONS FOUND IN NATURAL FOOD.

But quantity is not the sole consideration. The caloric value of a diet may be perfectly correct, and yet such a diet, from the point of

view of balance or make-up, may be thoroughly unsound. An infant requiring 560 calories in the twenty-four hours, for instance, could not live for long if the necessary number of calories were supplied by eight ounces of bread, six ounces of sugar, or four ounces of cream. Analysis of the food provided by nature for young mammals shows that the three main constituents in the food vary considerably in their relative proportions, and they vary in accordance with the particular needs of the animal in question. In some there is a predominance of nitrogenous food, in some a predominance of fat, in some of sugar.

Protein, or the nitrogenous elements, are provided in large relative proportion to the young of those animals which grow quickly ; fat, which is useful for the production of heat, is found in higher proportion in the milk provided for those young mammals who are exposed to great external cold. Sugar is found in liberal amount where the young animal is particularly active.

The human baby under normal conditions requires only a small amount of protein, for he grows slowly ; only a moderate amount of heating material, for he is kept warm ; but rather a liberal amount of sugar, for he displays much energy. When we examine human milk we find

that these three bodies exist in certain proportions :—

Protein 1.5 %, fat 3.5 %, sugar 7.0 %.

To this standard we should adhere throughout the first year of life in all cases in which artificial feeding is necessary. We should not depart from these proportions from week to week or from month to month as the child grows older, but should remain faithful to them from the day the baby is born to the day of weaning.

REQUIREMENTS OF THE WEANED CHILD.

When we arrive at the stage when solid food is required, these principles should not be relaxed, for there is still the need for nitrogenous foods, fats and sugar in these same proportions, unless there is some new condition introduced into the infant's life at the time of weaning which necessitates a change. In the vast majority of cases there is little change, and yet the dietaries usually adopted would suggest some radical need for a modification of balance. The only important change is that an infant grows rather more slowly after weaning than in the early months of infancy, and therefore requires, in accordance with recognised principles, rather less nitrogenous food.

But what do we find in actual practice? We nearly always find that his food consists to a large extent of undiluted cows' milk, in which the relative proportions are totally different from those of human milk or humanised cows' milk, and in which the amount of protein is disproportionately high.

The proportions of the three main constituents in cows' milk are as follows :—

Protein 4.0 %, fat 3.5 %, sugar 4.0 %.

Again, as the child acquires the use of his legs, will he require more or less carbohydrate food than he did when he was lying on his back? Obviously, if he is doing more muscular work, he ought to have more sugar or starch than when he was relatively inactive. We may say, then, that the weaned child requires rather less protein and rather more sugar or starchy food than before weaning ; this is exactly the reverse of what we find if we examine the majority of published food dietaries ; in most of them the protein allowance is increased one-hundredfold. Now if these mistakes are so common—almost universal—do such defiances of principles bear consequences proportionate to the crime? I feel sure that, in spite of the wonderful elasticity of the human organism, and especially the

young organism, most serious injuries are inflicted by neglecting to follow a right standard. An excessive nitrogenous diet, even when given in the least harmful form, always leads to pathological results. The common results in children are intestinal toxæmias, liver attacks, migraine, neurotic conditions, sleeplessness, offensive breath, muddy complexion, eczema, and a thousand and one ailments commonly regarded as "gouty."

In connection with the subject of a properly-balanced diet for young children, we must still think of the accessory food factors, or vitamines, and see that they are present in adequate quantities to secure normal development and growth. Although these principles are well remembered up to the time of weaning, they are often neglected afterwards.

TEETH REQUIRE SOLID FOOD.

At about the time of weaning there is one pronounced change which takes place, and that is the eruption of the teeth, which carries with it the associated demand for solid food. The stomach has been prepared for this—has been trained to tolerate it by means of the curds thrown down in its interior by the action of rennet on milk. If it were not for this early educa-

tion the stomach would revolt against the change. This is one of the reasons why patent foods, which do not become solid in the stomach, are incomplete foods.

The first kind of solid food commonly substituted for milk is some form of bread or biscuit. The capacity of the infant to digest food of this kind varies enormously, and depends on the experiences to which he has been subjected prior to the change. If the child has been properly educated, he will find no difficulty in taking bread, biscuit or cake. A bottle-fed infant can begin at one month, or even before, to take weak barley water made from pearl barley, and later can have cereal concoctions or bread paps, which contain more solid starch; in this way he becomes very proficient in the digestion of starch by the time he is weaned.

I am often asked at what date breast-fed babies should be taken completely off the breast. As long as the mother is in good health and prepared to make the sacrifice, I see no reason why the baby should not have a pint of breast milk in the twenty-four hours in addition to ordinary solid food for several months after he has begun to take the latter. Infants do not become rickety because breast milk is continued too long, but they often fail in nutrition shortly after

the eruption of the teeth if no other food than breast milk is given them.

The caloric value of starch is practically the same as that of sugar, *i.e.*, about 116 calories per ounce, so that if it is introduced into the infant's diet, it must be made to act as a substitute for sugar and not given in addition to it ; if starch is given, a corresponding amount of sugar must be withdrawn, otherwise the balance between carbohydrates and other food elements will be disturbed.

PRINCIPLES WHICH MUST NOT BE IGNORED.

The problem of feeding cannot be solved without following certain principles, some of which are here given :—

(1) A definite amount of food is required by every infant in the twenty-four hours. Each has its requirements, but within limits they conform to certain standard figures. We can use this standard with modifications according to existing circumstances.

(2) Quantity is important, and can be arrived at more or less accurately.

(3) The balance or make-up is equally important. Breast milk represents a correct balance.

(4) At the time of weaning no new circumstances are introduced which call for an appreciable change in "balance," except that rather more carbohydrate food and rather less protein is required.

(5) This balance is more or less applicable all through childhood and even in later life.

Owing to our national partiality for cows' milk, the balance is upset, and children are fed on food of enormous nitrogenous value. During the time of weaning, when new sorts of food are introduced into the child's diet, the change should be done in such a way as not to alter the amount nor the balance, and it should be based qualitatively and quantitatively on accepted standards.

This cannot be so simple a matter as it appears, or else the daily crime of unsound dieting at the time of weaning would not continue. It is a most difficult matter to draw up a correct diet sheet for a young child. At this stage food must be given for the purpose of eliciting the habit of mastication. If nothing but liquid and pappy food is given, the child will continue to swallow and not learn to chew. We must consider the transition to the spoon and cup or spoon and plate stages.

CHANGING THE HOURS AND METHOD OF FEEDING.

First, as to times of feeding. The infant before weaning is usually fed regularly from the bottle or breast six times in the twenty-four hours—three-hourly feeds during the day and no feed during the night. If this plan is well-established during the first seven, eight or nine months, good habits will be instilled, but this plan cannot be carried on indefinitely. After nine months, or even before, the infant should begin his descent or ascent to three or four meals only in the twenty-four hours. The transition from six to three meals a day is difficult to arrange. It may be desirable to change from six to five meals at seven months, and by the time the baby is eight months old, to four; but the change must be made gradually.

Then, as to the method of feeding, the change to spoon-feeding must not be adopted suddenly. When the child is some six months old, it may be a good thing to accustom him to the change by giving half of one bottle with a spoon, and perhaps one meal entirely at eight months. Then it is easy to drop bottle-feeding and feed only from a spoon. The first solid food may be in the form of bread and butter, or rusks, or sponge fingers or cake. These foods consist

largely of starch, and the infant must be gradually trained to digest starch by having it in a simple and weak form, such as barley water, long before the time for weaning arrives. It is very important that, as soon as the teeth appear, the child should be taught to use his jaws. Therefore we should not give soft food exclusively. The child must learn to masticate and not to swallow his food whole. Our children are usually taught, almost as if from malice aforethought, to swallow their food whole without mastication by giving them porridge, Benger's food, and other soft paps at the very time when they learn most easily, and most quickly acquire habits. This is exactly what is not wanted. If we think oatmeal is desirable, we can give it in the form of oatmeal biscuits. The same criticism applies to meat. It should not always be minced up, giving the child the idea that it is meant to be swallowed whole.

It must also be remembered that if a child consumes any considerable amount of solid matter, this addition to the caloric value of the diet should be taken into account in making out the diet sheet. Soon after weaning a small amount of milk pudding may be given. But the danger is the same as in the giving of porridge,

namely, that semi-solids of this kind teach the child to swallow carbohydrate food without mastication. Still, in moderation, they are useful kinds of food, and with them there should be some sort of fresh fruit; baked apples, stewed prunes and apricots are especially good.

The mid-day meal should be reserved for little experiments with new foods, such as mashed potato and gravy, bread crumbs and gravy, yolk of boiled egg; well-boiled and sieved vegetables, such as Jerusalem artichokes, brussels sprouts, etc. A little later other vegetables may be tried; they are very essential for health and are sadly neglected among the poorer classes. Some vegetables are not suitable for weak digestions, but vegetable marrow and Jerusalem artichokes are easy to prepare and to digest.

When a child is a little older, well-mashed and boiled parsnips, carrots or turnips are good. As for fruits, the pulp of apricots or boiled prunes put through a sieve may be used. It is impossible to give in this chapter a complete set of diet sheets, but, as an example, I supply one for children between the ages of twelve months and two years, which fulfils, as far as I have been able to make it fulfil, the essential conditions of caloric values, balance and other physiological requirements.

DIET SHEET FOR CHILDREN FROM 1 TO 2 YEARS.

Breakfast.	Dinner.	Tea.	Supper.	Total Number of Calories for 24 Hours. Standard 840–1120
Milk, 6-8 ozs. Sugar, ¼ oz. Cocoa, ⅛ oz. Bread, Toast, Rusk — Singly or combined, 1-1½ oz. Butter, Margarine, Dripping, Bacon fat, &c. — Singly or combined, ¼ oz. Jam (without seeds, pips or skins), Jelly, Treacle — ¼-½ oz. 292-351 calories.	Whiting, 1-1½ oz., stewed in milk, 2 oz. Potatoes, 1-2 ozs. Carrots, turnips (mashed) *or* boiled onions (Spanish) 1-2 ozs. Suet pudding, 1½-2½ ozs. Treacle, ¼-½ oz. Bread, 1 oz. 357-527 calories.	Milk, 6-8 ozs. Sugar, ¼ oz. Cocoa, ⅛ oz. Bread, Toast, Rusk, Plain Madeira cake, Oatmeal biscuits — Singly or combined, 1-1½ oz. Butter *or* margarine ¼ oz. Jelly, treacle, *or* jam without seeds, pips or skins, ¼-½ oz. 292-351 calories	Broth (vegetable), 3-4 ozs. 40-50 calories.	981–1279

In conclusion, let me emphasize the importance of the psychological aspects of the dieting of children at this age.

Permanent tastes are acquired very easily at the period of life. As a rule children dislike foods which are forced on them, or those which are said to be good for them, and they take strong fancies to foods which they are not allowed to eat; advantages should be taken of these tendencies.

CHAPTER VI.

THE FORMATION OF HABITS GOOD AND BAD.

WHEN I decided some little time ago to speak on the subject of habits, I had no conception that I should find so much difficulty in compressing what I had to say on this question within the limits of one lecture. *Habits, though frequently so described, are not, strictly speaking, man's second nature* ; they are his essential nature,* and, consequently, a proper understanding of them implies a very considerable knowledge of the biological principles which are involved in life. I therefore despair on this occasion of being able to give you more than a very superficial account of what habits really are, and how both good and bad ones may be acquired.

Ambitious though the project be, I propose to attack the immensely difficult problem of the ultimate analysis of habits in language that may be understood by any person, no matter how incomplete may be that person's knowledge of

* Habit is, as it were, a second nature.—Cicero.
Habit is stronger than nature.—Quintus Curtius Rufus.

scientific terms; whether I shall succeed or not, is altogether another question.

Some of our habits are born in us, others develop after birth. The first group consists of automatic and necessary habits, such as are displayed by the rhythmically beating heart. To the second group belong such habits as the rhythmical movements of respiration, which are set in motion immediately the infant commences its independent existence, and which are equally necessary to life. The automatic habit of sucking, the movements of the stomach and bowel, as well as all those many simple organic functions which are more or less, but perhaps not absolutely, necessary to individual life, are all hereditary habits which belong to the same category. These functions represent very ancient ancestral habits of a very permanent and stereotyped character. They are, in fact, so inseparably bound up with, and form so essential a part of our lives, have been so incessantly repeated, and so firmly engrafted in our organic constitution, that we do not usually regard them in the light of habits at all. *They constitute, in fact, man's first nature.* Other habits, which, though not absolutely indispensable for life, but which are, all the same, more or less essential for a complete and healthy life,

have to be learned and acquired independently by every new-born infant. *And these habits constitute man's so-called second nature.* Some of these acquired habits are simply and easily learned, as, for instance, the habit of walking, the use of the hands, the habit of speaking, of seeing, and of hearing. Others in which the intellectual faculties are more completely concerned, are acquired with a greater or less degree of difficulty. Habits, then, whether they be born in us, or are subsequently acquired, *constitute man's essential nature, and they are the results of experience or education.* Our education does not begin when we commence to learn to read or write, nor does it commence when we learn to breathe or suck. It has been steadily going on ever since our first foundations were laid in the immeasurable past. The education of the infant consists in teaching him how to acquire good and useful habits which are not in-born, and which will enable him to live a complete life, and take full advantage of the opportunities of his surroundings or environment. In order that we may live the healthy and vigorous life, as infants we must breathe and digest properly ; but, in order that we may reap to the full the advantages of our varied environment, we must be taught the use of our

eyes, our ears, our tongue, and our hands. A knowledge of how to do these things properly can only be acquired by providing the right sort of experience, the right sort of education.

The object of this lecture is to try and explain to you some of the directions in which an infant may be educated with the greatest success from the point of view of prospective rather than immediate advantage; how, in fact, *to surround it with the best possible environment, and thus produce the best possible habits.* As I said at the commencement of this lecture, to understand how a simple organic function is performed; in other words, how a simple habit is acquired, necessitates a very considerable knowledge of physiology. You will therefore forgive me if, before I pass on to the practical side of the question of habits, I try and explain to you a little about the physiological principles involved in a simple vital act.

When there is a difficult matter to explain, it is generally found best to commence with a simple illustration, and then to pass on to those which are more complicated. Therefore let me explain to you the physiology of a very simple vital habit. If you walk across a lawn on a dull summer's morning, you will perhaps hardly notice the presence of a daisy. But, if the sun

suddenly passes from behind a cloud, in a few minutes the whole lawn may be spread, as it were, with a white cloth, and every daisy will have expanded its petals, and turned its face to meet the golden beams of sunshine. This is the habit of the daisy—one of its few habits—for owing to its simple structure it can take little notice of most of the events that are going on around it, and pays no attention to the vast number of changes which occur from moment to moment in its surroundings, changes which might and do provoke varied responses or excite many an emotion in highly complicated animals like ourselves. Expressing, then, the behaviour of a daisy under the influence of sunlight in more scientific terminology, we say that it responds to the stimulus of light by a particular act of growth, and by turning its face towards, and expanding its petals away from, the source of illumination. There are not many forms of stimuli or changes in the surroundings to which the daisy can or does reply. We, on the other hand, are so immeasurably complicated in our structure that we can respond to almost every variety of change that occurs in our environment. As we walk across the lawn, we can feel the sun's warm rays, we can see its brightness, we can smell the flowers, we can

gather them, and we can approach or avoid objects that please or displease us; we can hear the birds singing, and, in fact, there is no form of change occurring in our environment that cannot be appreciated by one of our many senses, whether they be of sight, of sound, of touch or of smell, and we can do all this by reason of the possession of a vastly complicated nervous system, which is specially designed for the reception of all these various forms of stimuli. As infants or children we make educational progress the moment we learn to respond to any new form of stimulus with which we are previously unacquainted. And when we have responded to the same stimulus on several occasions, and in exactly the same manner, we have practically formed what we call a habit.

I have found on occasions when I have been anxious to describe the working of our vastly complicated nervous system, that a comparison between it and an extensive telephonic system, such as we have, for instance, in London, makes the explanation very much easier. I propose, therefore, to adopt this method of description in explaining to you the part the nervous system plays in the determination and display of habits. Our nervous system, then, may be compared to a great telephonic organisation. The so-called

end-organs of our sensory nerves (for example, the retina in our eye, the taste buds on our tongue, and the tactile nerve filaments in our finger tips), which are adapted to receive the various external stimuli of the environment—that is to say, the stimuli of light, of taste and of touch—may be compared to the telephone instruments which are installed in our houses, in our hotels, and in many other places, to receive the stimulus of the human voice, and transmit it to its required destination. The nerves which run from these end-organs to the spinal cord and brain may be compared to the telephone wires which run along the tops of our houses, or under our pavements, and the nerve cells in the spinal cord and brain with which these nerves are connected may be compared to the telephones at the local exchange which are, or should be, answered by the telephone attendants. The convolutions of the brain, the seat of the intellect, may be compared to a central bureau of information which is in close connection with all the local exchanges. If, then, for instance, a beam of light passes into your eye and you wink, you may describe this phenomenon, according to the simile I have adopted, in the following language: the telephone installed in your eye rings up the local exchange and is

at once put in communication with the central bureau. If the connection be satisfactorily made, the message will go through, saying that the eye is being damaged by too much light, and the central intelligence bureau will, in its turn, ring up the appropriate local exchange, and send the message down to the eye-lid to close immediately, and, if everything goes well, the message will be complied with — and you will wink. In this way all sorts of complicated messages can be received by the various telephones installed in different parts of the body, and all sorts of complicated replies can be sent out by the intelligence bureau.

The nervous system of the new-born baby may be compared to a *new* telephone system which has only been recently installed. All the telephones are in position, the wires laid and connected, and all the exchanges completed, but the operators are without experience, and the intelligence bureau without information or direction. Only the very simplest messages can be attended to. At all the local exchanges the wires are so arranged that those telephone numbers which are calculated to be most frequently used in connection with one another are placed side by side in the most handy positions. These arrangements are made in accord-

ance with past experience in the organisation of other exchanges (ancestral experience), and in this manner new-born infants very early fall into the habits into which other babies have fallen before them. Every baby that is pricked, for instance, with a pin, will cry out, even though it has never felt a pin before. This is because the baby's ancestral representatives have always responded in this way under similar stimulation, and because at the exchange it is easier for the unpractised operator to connect up the number corresponding to "pin" with the number corresponding to "cry," than to connect either of them up with any other number. If a baby were pricked every day with a pin, the operator at the exchange would soon become so quick and expert, that in a very short time the mere sight, much less the feel, of a pin, would cause him to connect the message up with the "cry" number at the central bureau, and the infant would howl its loudest from habit.

The plastic impressionable nerve cells of the developing infant, in other words, the apprentice operators at the local exchanges, are so easily trained to respond to any particular form of stimulus or call, that it is impossible to emphasize too strongly the importance of giving the

right calls at this period. It is very much easier for them to repeat something they have done before than to originate something fresh. The messages, therefore, should be given slowly and distinctly; that is to say, the stimulus applied should be adequate, but not too powerful—so that the first response may be of a type that may serve as a good example for future rejoinders. If you fire off a cannon in the mouth of the transmitting telephone, an inexperienced operator at the local exchange may be temporarily deafened or made nervous, and he will probably switch you on to the wrong number, with the result that you get an unexpected, and possibly an impertinent, reply. This is exactly what happens in the case of infants mismanaged from birth. To take a simple instance—if you pour an indigestible meal of food into the stomach of a new-born infant, all sorts of incoherent messages are sent by the nerves of the stomach to the local exchange, and the operator, in a state of confusion and bewilderment, probably connects the stomach telephone with all sorts of wrong numbers, and the infant, as likely as not, cries or is sick. The experience of this early lesson is probably remembered by the operator, and the next time the stomach rings up it will be connected with the same telephone.

and the same lamentable result will follow ; thus may a habit of vomiting be induced. It is the almost universal experience of those whose business it is to train dogs, horses or other animals, to find that it is far easier to teach a new habit or trick than to break an animal of an old one. One would think that the application of this knowledge to the education of infants would by this time be the common property of all nurses and all mothers, but, as a matter of fact, this is very far from being the case.

If you want to train the various exchanges or nerve centres in well-disciplined habits, you must begin with very easy lessons, and advance only slowly to those that are of a more difficult nature. This is the *alpha and omega* of infant education.

The important and essential part that the nervous system plays in the performance of every vital act, or in the inducement of every habit, is the reason why I insisted so strongly in my second lecture on the necessity of protecting the nervous system from adverse influences or experiences during the early stages of its development in the uterus of the mother. An early experience of alcohol or auto-intoxication will certainly tend to produce an unstable nervous system, which is exceedingly difficult

to train in regular and orderly habits. If I may continue my simile of the telephonic system, I would liken the instability of nervous systems developed under such circumstances to the conditions of chaos, which one might imagine in a nightmare to hold good in telephone exchanges if all the wires were tangled up in an inextricable jumble, if all the numbers on the instruments were changed, and if all the operators themselves were mentally deranged. Under such circumstances messages would be unlikely to reach their proper destination, the simplest organic functions would go awry, and the inducement of good habits would be impossible. If you supply an extremely neurotic infant with food that might be admirably adapted to the needs of a well-conditioned baby, it will hiccough, be sick, or have diarrhœa, and if you let it breathe fresh air it will sneeze, or catch a cold; indeed, whatever you do to it, whatever stimulus you apply, you may be perfectly certain that it will always give the wrong answer, and never give it in the same way twice. It acquires, in fact, a habit of always behaving in an eccentric and erratic manner, a habit which persists throughout life, and which is highly characteristic of the neurotic or nervous temperament of grown-up individuals.

If you can picture in your minds my nightmare-like conception of a telephone exchange going wrong, you may form a very good idea of the sort of chaos that reigns in the brains of insane, imbecile and demented persons; you may also be able to obtain an intelligible explanation of those occasional gleams of genius that emanate from individuals of this kind. The attractiveness of the neurotic (and may I suggest the artistic?) temperament is not improbably associated to some extent with the same kind of undisciplined mental equipment; from brains which are organised on these irregular lines you hardly expect the same kind of response that might be anticipated from a well-trained common-place nervous system, and, whether you expect it or not, you certainly do not get it. Neurotic individuals have an original way of looking at things, and most of the great things that have been done in this world have certainly been done by geniuses who have had anything but disciplined brains. Thus are there compensations. The ultimate analysis of genius, of intellectual precocity, of moral insanity, and many other mental conditions, is a study of much fascination.

I should naturally like to discuss these various habits in their order of relative importance, but

the more I weigh their respective claims to this honour, the more difficult do I find it to decide which ought to be taken first. If, therefore, I give to sleep, " Nature's soft nurse," the pride of place, it is not necessarily because I think its claims are greatest, but because I do not know of any habit that has greater.

It is a striking characteristic of our highly complicated nervous system that it tends to fall into rhythmical habits of activity, alternating with rhythmical habits of rest. This is a general law that seems to hold good throughout Nature, and one that is by no means peculiar to nerve cells, which are the most highly differentiated forms of living matter. The periodic or rhythmical habits of the nervous system confront us on every side. The regularity of the pulse at your wrist is one of the most striking examples of a rhythmical habit impressed on nerve cells. The regular periodicity of our respiratory movements tells the same tale, and, if you will examine it, you will find that your daily temperature chart shows the same regular variations day after day. Again, if you should be so unfortunate as to suffer from neuralgia, you will generally find that your enemy attacks you at precisely the same moment every day. This tendency on the part of the nervous system

to fall into rhythmical or periodic habits of activity and rest, has its uses as well as its disadvantages. In the promotion of regular habits of sleep, it is a tendency of which we should take full advantage. The new-born infant has not, as a rule, any preconceived and definite views as regards sleep—its inclination is rather to sleep on unless disturbed; it presents a magnificent virgin field for educational discipline; you can do what you like with it. You can introduce any periodicity for which you have a preference. Most people seem to have a fancy for the three-hour rhythm, that is to say, they wake the infant up every three hours and feed it. If you do this with perfect regularity every day, in a very short time you impress this habit of rhythm on the nerve cells in the brain which subserve consciousness, and the infant will wake of its own accord every three hours and cry out for its bottle.

This is why we say, "feed the infant by the clock, and not by guess work." It is one of the easiest things in the world to induce regular hours of sleep if you adopt this systematic method from the moment the child is born, but personally I find it most difficult to get any nurse to carry out this system conscientiously. The mother says, "the dear child is sleeping, let it

sleep, sleep will do it more good than anything else ; it is sure to wake up soon, and then we can feed it " ; or the nurse says, " mother is sleeping, and I am sure she requires rest ; let us wait till *she* wakes." Or, perhaps, the child does not seem quite comfortable after a feeding ; it has to be carried about, and nursed and coaxed and kissed when it ought to be returned to its cot and compelled to sleep. In fact, every conceivable thing is done to interfere with the development of an advantageous rhythm in the sequence of rest and activity in the nerve centres concerned in consciousness. Infants are very fond of being nursed and joggled and rocked, probably for the reason that intermittent and periodic movements of this kind harmonise with the natural tendency inherent in the nervous system to fall into rhythmical habits. Like all other fidgety habits of the same nature, these are very bad for the child, for they not only accentuate any natural predisposition there may be to neuroses, but they may even shake the equilibrium out of nervous systems which are disposed to be stable. In order, therefore, that advantageous habits of sleep may be induced, very shortly after a baby has finished its feed it should be returned to the cot and made thoroughly comfortable ; care should be taken

that its feet are warm, and that its napkin does not require changing, but on no account should it be taken up and nursed; every temptation to do so must be resisted; there are, indeed, as a rule, few temptations in this direction, unless the infant has already been mismanaged and has contracted bad habits. In such cases one has to harden one's heart and be very firm, for, as I have already said, *it is very much easier to induce good and new habits than to eradicate old ones that are bad.*

In certain cases it may be difficult to induce good habits of sleep, even when the educational discipline is of the best; when this is so, it is generally because the nervous system is refractory to learning. I am not quite convinced that the foundation of habits of sleep—both good and bad—is not sometimes laid during the ante-natal period. It is not always easy to explain why it is that the "fœtus" in utero takes it into its head to enjoy its physical exercise at certain more or less definite hours of the day or night. Some pregnant women complain that the fœtal movements regularly keep them awake at certain hours of the night—others, that the fœtus begins to kick as soon as they themselves go out for a walk. If this be the case, there must be some definite reason, for effects do not follow without

causes, and the cause is probably to be sought in some habit of the woman herself, or to some change in her blood which follows as the result of this habit. I should very much like to know whether a fœtus that has been in the regular habit of kicking at night turns out to be a baby that likes to keep awake at night, and to take its sleep during the day. I am very much inclined to believe that this is so, but I have not yet collected sufficient evidence on this point to be able to say more than that there seems to be some ground for believing my theoretical supposition to be true.

Leaving, then, the subject of sleep, let me turn to the consideration of quite another group of habits, namely, habits that are concerned with the digestive functions. In my first lecture I had a good deal to say on the subject of gastric education; I cannot afford the time to go over the same ground again, but I want to impress upon you *that no digestive function can be carried out apart from the co-operation of the nervous system.* If you teach the stomach to digest, you have trained the nerve cells in "the gastric exchange" in good and orderly habits, and this centre, like other centres, has a tendency under appropriate conditions to fall into rhythmical or periodic habits. That is the

reason why you are ready for your breakfast at the usual hour, and happy is the man who is ready for his food at regular meal times, and at no others, for this periodicity implies good manners on the part of the gastric centres.

Have you ever noticed how your appetite disappears if you are kept waiting too long for your food? This is because from habit your gastric centres are passing out of a phase of activity into a phase of rest, and it proves, if proof were needed, that we eat more from force of habit, than because our general organisation stands in need of food or nourishment. Infants who are fed at irregular hours stand a very poor chance of acquiring efficient gastric functions, for the centres which control these functions must be trained in regular and periodic habits; so that when they are working they may work at their best, and when they are at rest they may have ample opportunities for recovery.

Closely associated with regularity in the habits of digestion is regularity in the behaviour of the bowels. To this subject I have paid very particular attention, and from practical experience I can assure you that no "exchange" in the human economy is easier to train, and that none proves a more obedient servant, if only the

educational discipline be applied at the right time, and in the right manner.

Now the telephonic call which rouses the "bowel exchange," or, as it is technically called, the "defæcation centre," is not altogether a simple one like those that subserve certain other organic functions. The reflex is a more or less complicated combination of several calls, in which certain psychological events that pass in our brain are more or less directly concerned. If the "defæcation centre" has been in the regular habit of coming into activity at one particular hour every morning, although it will not work quite spontaneously from sheer force of habit, nevertheless it requires a very small stimulus to make it do so. Any particular association of ideas may be sufficient for the purpose. I need not specify the sort of stimulus required.

Now the best sort of stimulus to apply to an infant, who has to be taught regular habits of this kind, is the rim of a soap dish or bowl in contact with its buttocks; by a sort of semi-conscious association of ideas a *baby will soon learn to recognise that when this stimulus is applied it is a peremptory order for the defæcation centre to act.* The difficulty that a nurse has in carrying out this educational régime is to

apply the stimulus at the psychological moment —she must wait her opportunity, and if she is quick she may be in time to apply the stimulus before the relief of the bowels is completed. If this has been done two or three times with success the infant will learn to obey the order at about the same hour next day, even without any very imperative call, such as the pressure of fæcal matter in the lower part of the bowel. *It is perfectly possible, and it has been done over and over again, for a clever nurse to induce regular habits of this kind in an infant of less than six weeks old.* Habits of this kind are a real and valuable asset for any individual, and I know several children, whose ages now vary from four to eight years, who have never required a purgative at all, owing to the successful carrying out of this method.

Now before I leave this subject of the education of the bowels, I must refer to a very important point which is intimately associated with the régime I have already described : it is this. Regularity in the times at which the bowels act, though an essential element in successful training, is not the only element : *the bowels must act strongly and forcibly ;* but no organ or muscle in our bodies will act strongly and forcibly unless it is given a certain amount of

work to do. Now the great majority of modern infants, especially those that belong to the upper classes, and who are fed on large quantities of food that cannot possibly be absorbed, pass large soft pultaceous motions, which through sheer weight gravitate through the bowel. No muscular effort of any kind is required to expel stools of this character from the lower part of the bowel. Now from an educational point of view, it is well when a young infant passes a small, relatively hard, formed motion, a motion, in fact, that looks as if it had been in the grip of the bowel, and had required some intestinal force to accelerate it on its journey. When this is so we know that the muscles of the bowel, the muscles of the abdomen, and the muscles of the pelvis have had a lesson in gymnastics, which will go a long way towards making them good and serviceable muscles, the sort of muscles that will work without a whip, a spur, or a purgative. Now it is very unfortunate that when an infant passes a more or less hard and formed motion of this kind, the nurse or the mother usually becomes alarmed because in character it may not coincide with her ideas as to what a stool ought to be like. She says the infant is dreadfully constipated, or that "it actually strains"; as the treatment of constipation usually comes under

the jurisdiction of the mother, a dose of castor oil, fig syrup, or gray powder, is immediately administered; sometimes an enema is injected, or a glycerine suppository inserted in the bowel. What can be more fatal to educational discipline? If you give a medicinal dose of this character, if you inject an enema, or insert a suppository, you are doing what is tantamount to firing a cannon at the head of the operator in "the bowel exchange." Of course he hears you, and in his hurry and consternation he connects you up with every telephone on his switchboard, and you get what is popularly called a magnificent result. But how about next day? Does he hear you when you apply the usual call? No, of course not, he is expecting the report of a cannon, and the rhythmical sequence you have been labouring so hard to induce in this particular exchange is broken, and the sensory perceptions of the operator are temporarily dulled by over-stimulation.

You have, indeed, obtained a magnificent result, but at the cost of much prospective gain. Genuine constipation is quite a rare event in infancy, and especially in the case of babies who have been properly fed, but this hard formed condition of the motions is so often treated as if it were constipation that I feel I

cannot insist too strongly on the difference. The really common condition in infancy is comparative looseness of the bowels, a condition which, as I have already remarked, makes no call upon the muscular activities of the intestines; this initial looseness may be followed in early childhood by genuine constipation, and by genuine constipation I mean when the bowels do not act regularly; later, when the child is two or three years old, there may be the greatest difficulty in obtaining a satisfactory action of the bowels. This troublesome state of affairs is partly due to want of tone in the bowel and consequent dilatation, and partly to the want of grip on the bowel contents previously mentioned. The early education of the bowel is a very easy and simple matter; to correct the bad habit of constipation is a most difficult task—it cannot be done by drugs. Massage, abdominal exercises, diet, patience, and training are the only expedients that offer any prospect of ultimate success.

Now what is true of the education of the nerve centres which control the complicated muscular act concerned in the relief of the bowels is equally true of the training of the centre which presides over the functions of the bladder, and the same sort of discipline is effective in both cases.

The infantile bladder is a very delicate and sensitive organ; at first it will not stand any degree of distension, and the infant is constantly wetting its napkins. *The chief object of bladder education is to induce a certain amount of tolerance, and to bring about an advantageous periodicity in the times of micturition.* This can be best done by "holding out" the infant at regular intervals, and training it to recognise "the chamber" as the psychological stimulus, just in the same way that a horse can be trained to regard the presence of straw in the same light.

It is when the education of the bladder is neglected that we get those intractable cases of nocturnal enuresis, or bed wetting, in children which are alike the despair of doctors and parents. It is very easy to induce discipline in some micturition centres, in others—and especially in those of neurotic infants—it is a matter of great difficulty. In infants who are thoroughly degenerate, who suffer from frequent convulsions or epileptic fits, it may be almost impossible. All sorts of explanations and theories are occasionally offered with regard to the causation of nocturnal enuresis. There is no need, however, to look to anything further than the condition of instability of the nervous system, or the want of training; if the former be

of the type that I have compared to a disorganized telephone exchange, good discipline can only be induced with great difficulty, and it is in the undisciplined condition of the micturition centre that the cause of "nocturnal enuresis" is to be sought. It is perfectly true that all those conditions that militate against stability in the nervous system contribute also to instability in the micturition centre; but it shows a great lack of appreciation of the important and fundamental principles involved to imagine for one moment that any one of these contributory factors is the actual "*cause*" of bed wetting. Ill-health in the mother before the birth of the infant, indulgence in alcohol, or drugs, or the effects of maternal auto-intoxication, are just as much contributory factors in the causation of bed wetting in the child, as are indigestion, or auto-intoxication from over-feeding in the infant itself; but none of these factors are the actual or sole cause. The cause lies in the want of discipline in the centre itself. The cure of nocturnal enuresis is always difficult as compared with its prevention; but it is very much easier to carry out if the principles above enunciated are thoroughly understood.

I now come to what I consider to be *one of the most important items in infant education*,

namely, the training of the centres or exchanges which regulate the bodily temperature. These centres are so exceedingly complicated, so widely distributed throughout the nervous system, so difficult to understand, and their duties are so closely associated with our health and comfort, that I am sure you will not begrudge me the time if I enter somewhat thoroughly into a number of details which are requisite for a proper understanding of the manner in which they work, and of the manner in which they may be efficiently trained.

The heat regulating nerve centres, or, as I may more shortly call them, the "Temperature exchanges," have for their duties the maintenance of a constant, or of a practically constant, temperature in our bodies. As you all know, this constant temperature in the human body is about 98.6° F., a temperature which is called the normal blood temperature. Now it is a matter of very great importance to all of us that this normal temperature should be maintained under all circumstances: in the presence of external cold, or of external heat, or in the face of internal derangements which are calculated to upset it in one direction or the other.

This temperature of 98.6° F. is the one which our vast ancestral experience has taught us is

the most favourable one for the promotion of our vital activities, for securing our comfort, and maintaining our health. If circumstances arise, with which the heat regulating centres are unable to cope, we pass either into a condition of fever, or into one in which the temperature is sub-normal—both of these conditions are unfavourable to the maintenance of our normal vital processes.

The "temperature exchanges" are connected up by a very complete system of nerves or wires with every part of the body, both on the surface and within its interior. If the body is exposed to cold, the nerve endings in the skin are stimulated; in other words, messages are sent to the exchange reporting from the points of observation that the body is in danger of becoming chilled, and that it is essential that the internal furnaces should be urged to freer combustion. If the exchanges are properly organised, messages are immediately transmitted for fuel to be heaped on all the vital fires, and the internal temperature is raised so as to counteract the influence of the external cold. Increased combustion is brought about in the body by the quiet unobtrusive burning or oxidation of combustible material in the muscles, liver and other large organs.

On the other hand, messages may arrive at the centres reporting that the external temperature is excessive, and that the temperature of the blood is in danger of rising above the normal level. When such is the case, the exchanges send out messages to the sweat glands in the skin to secrete water, and thus to cool the skin by reason of the evaporation that ensues, and at the same time directions are given to the stokers to damp down the vital furnaces.

In these ways the normal temperature of the blood can be maintained under almost every variety of conditions; with well-regulated centres you can remain in a Turkish Bath at a temperature which is sufficient to boil water or roast a leg of mutton—or you can survive a temperature which will almost freeze mercury. The essential condition, however, is that your heat-regulating nerve centres should be well-trained and in good working order.

The education or training of these centres is therefore a matter of very great importance. At the time of birth the whole system of telephonic communication necessary for the adjustment of the bodily temperature is completely installed, but the workers at the exchanges are untrained and unskilled, and the operators at the various points of observation have still to learn the dif-

ference between heat and cold, and to send orderly and coherent messages in accordance with orders received.

Before birth the fœtus has only had one experience of temperature, and that temperature is the temperature of the maternal blood. It has therefore to learn its temperatures lessons *de novo* after birth. If you expose a new born baby to extreme cold, its temperature will immediately fall, and, if this fall is excessive, its vital activities may become so depressed that it stands in great danger of perishing. The early Spartans regarded the test of cold, when applied to the case of the new-born baby, as a most reliable means of distinguishing between children of sound and of unsound constitution. All new-born babies had to pass their first night in the open air on the slopes of Mount Taygetus, and the less vigorous among them naturally perished, and were saved from taking part in further competitions of fitness, in which they would almost certainly have failed.

I don't suppose that many modern infants would survive such a severe test, but on a smaller scale a large number of them are unwittingly exposed to a similar kind of ordeal. It is impossible to exercise too much care in protecting new-born babies from the influence of

cold; it is better to wrap them up in hot cotton wool and blankets, and almost to suffocate them, rather than to let them run the slightest chance of experiencing a fall of temperature from insufficient protection. Many dangers lurk in the initial bath; some nurses are most careless in the manner in which they wash babies for the first time after birth. They either wash the infant piece-meal, and leave the unwashed parts unprotected, or else are so slow over the operation that the infant has many opportunities of becoming chilled. The temperature of the first bath should be as nearly as possible 99° F.; the baby should be rapidly lathered in hot soap suds, and plunged into the bath, and then dried with equal rapidity with a hot dry towel; the whole operation should not take more than three or four minutes—indeed, it can be done in less.

Although, as I say, at first the temperature exchanges of the new-born infant are not in working order, nevertheless they are very amenable to educational discipline, and they soon learn their business if properly taught. Every day they should acquire some new experience. The temperature of the room in which the infant sleeps should at first be kept almost uncomfortably hot; the clothing should be almost unnecessarily warm, and the bath, as

I have said, should be just above blood temperature; in a few days, when the baby has settled down to its new surroundings, the temperature of the room may be reduced by gradual and slow degrees, the clothing may be made less warm, and the temperature of the bath may be lowered; later on the infant may be taken from room to room of different temperatures, and at the end of ten days or so may be taken out of doors.

With the same kind of graduations the infant may be slowly habituated to various ranges of temperature, and to more or less sudden transitions. The child has to learn to accommodate itself to sudden changes as well as to intense changes of temperature, and in this way chills and colds are obviated. Each progressive step must, however, be thought out with the greatest care and deliberation if you wish to get good results, and to provide the infant with a thoroughly efficient heat-regulating exchange.

I am sometimes amused when people write or talk on the subject of "the hardening of children," and infer that the whole idea is a mistake. I do not suppose for a moment that people who express these opinions have ever taken the trouble to think out for themselves what "hardening" really means, or have ever

arrived at the knowledge that "hardening" only means educating the heat-regulating centres; we might just as well say that we do not believe in teaching a child to swim, because a child was once drowned in acquiring this useful accomplishment. It is perfectly justifiable to find fault with the methods which have ended in failure, but it is absolutely absurd to condemn the whole idea on that account. If an infant has been consistently treated as a hot-house exotic, and kept at a constant temperature with no variations in thermal stimulation, it will be just as incompetent as a new-born infant to accommodate itself to any sudden change in temperature, or to the environment of a draught, and it will be just as certain to experience a lowering of vitality and contract a chill. No nerve centre of any kind should be submitted to any sudden shock, and more especially when this centre is young and inexperienced. If you and I, in whom thermal education was probably much neglected, are exposed to sudden cold, our teeth at once begin to chatter, and we shiver all over. This behaviour implies that we have passed the limit of quiet orderly accommodation, our centres have received so powerful a shock that they send ill-co-ordinated messages all over the body

to the furnaces that reside in our muscles. Thus, instead of quiet, active combustion taking place therein, the muscles immediately begin to display that irregular form of contraction or activity, which is known as shivering, or chattering of the teeth; any centre which has been exposed to rough treatment of this kind is sure to have its organisation temporarily upset, and this is more or less what we suffer from when we contract a chill.

I can speak with some experience when I say that it is quite easy to train a baby before it is three months old to stand a douche of cold water with the greatest impunity and indifference, which would certainly make me shiver all over. Children who are trained in this way never take a cold in consequence of a chill, or from exposure to a draught. It is true that they may be infected by another child who has independently caught a cold, but that is quite another matter, and altogether a different thing from contracting one for themselves. The training of the heat-regulating centres in degenerate or neurotic children is often difficult and slow. I feel sure that some of you would like to ask whether there is virtue in the modern and fashionable practice of sending children about in cold weather without stockings on the

legs, and with only sandals on their feet. It is this faulty kind of education that makes people say they do not believe in the hardening process. What a fearful tax it must be on the heat-regulation exchanges, when at the same moment messages arrive from the legs saying, "We are cold, pile on the fuel!" and from the warmly-clad body, saying "I am hot, pour on the water." In such a dilemma what are the distracted operators at the exchange to do? They find themselves in just the same sort of predicament, when a child at the seaside dabbles in cold water, and bathes its head at the same time in brilliant sunshine. The nervous breakdowns that ensue in the temperature exchanges, in consequence of treatment of this kind, give rise to that indefinite group of symptoms which, with our terminological impartiality, we sometimes call liver attacks, sometimes sunstrokes, sometimes chills.

There are a vast number of other directions in which the education of the infant may be pursued, but in which, unfortunately, I have not time to follow it on this occasion. I feel, however, I cannot leave this subject without some reference to the acquisition by children of certain objectionable practices or tricks, which, owing to the rhythmical automatism of the

various nerve centres, are only got rid of with the greatest difficulty. I refer, of course, to tricks of the nature of thumb-sucking, tongue-sucking, nail-biting, finger-fidgeting, and nose-picking. The formation of these habits is always in the first instance due to some definite stimulus, some definite source of irritation, and, if the stimulus be sufficiently prolonged and repeated sufficiently often, the nerve centre in charge of the particular muscular movements may fall into a periodic habit of activity, which becomes quite automatic, and independent of the original stimulus which first set it in motion. Thus, for instance, the habit of nose-picking is due to an initial irritation of the nasal mucous membrane, a very common condition in young infants, and thumb-sucking and nail-biting are either the consequences of irritation of the gums during the period of the first dentition, or, more often, the consequence of the use of a comforter or dummy teat. The comforter is an abomination of the worst possible description. The charge that is generally imputed to this horrible instrument is that it introduces all sorts of dirt into the mouth ; to my mind this is quite one of the least of its many offences. It certainly over-develops the centre which controls the act of sucking, and induces in it habits of continuous

and automatic activity. Children who suck comforters always have a number of restless, fidgety habits, they always want to have a bottle when they can get it, they suck their thumbs or anything else that comes handy, they become inveterate sweet suckers, and later in life the habit of cigarette smoking falls very lightly upon boys, and I would even go so far as to suggest that the habit of tippling in men is in some way associated with this early restless trick of sucking a filthy piece of indiarubber. Like the gastric centres, these centres which are concerned with the movements of the lips and tongue should be educated in habits of periodic activity alternating with habits of rest, and not in those of continuous motion.

Infant education, then, should aim at inducing regular, orderly, and consistent habits of obedience to certain definite and reasonable commands. It is absolutely fatal to infant discipline to humour its often refractory and perverse moods. The whole essence of successful training is to obtain definite and accurate responses to definite stimuli or commands. If character and temperament are capable of being expressed in physiological terms, I would hazard the suggestion that these terms must have reference to the various degrees of obedi-

ence offered by various nervous systems to calls or commands. If a nervous system is trained from earliest infancy onwards always to give a definite and certain response to the same command or stimulus, the habit of accuracy must be introduced. Accuracy of thought implies accuracy of response to definite impressions or combinations of impressions, and accuracy cannot surely be achieved in the complicated processes involved in thought and reasoning, unless obedience has been instilled in those less important nerve centres, which are independently concerned in the simple every-day functions of life, but which in combination are concerned in the higher intellectual functions.

More than two thousand years ago Plato expressed the opinion that the education of children should be entrusted to the wisest man in the state. If education really means what I have implied in this lecture, the wisest man in the state would have to attend to some very strange duties. But, to my mind, character and temperament are inseparably bound up with the nature of the early educational discipline to which infants and children are subjected, in fact

"The hand that rocks the cradle is the hand that rules the world."

CHAPTER VII.

RICKETS: ITS CAUSATION, SYMPTOMS AND TREATMENT.

ALTHOUGH rickets is a very common disease among children, if every symptom which is at times described as rickety or rachitic were really due to this disease, there would be very few childish ailments which would not come under this denomination.

I hope I shall not make confusion worse confounded by mentioning some of the more common of these symptoms, they are as follows:—

1. Delayed teething.
2. Sweating about the head.
3. Muscular weakness.
4. Lax ligaments.
5. A tendency to catarrhal affections.
6. Excessive fatness.
7. Nervous unstability, manifesting itself as convulsions, croup, tetany, etc.
8. Bony deformities.

I do not wish to suggest that these symptoms

are not found singly and in various combinations in indubitable cases of rickets, but the argument which I wish to develop is that the only feature of rickets which is pathognomic of and essential to the disease is the softness of bone. All the other concomitant symptoms represent the outward and visible signs of many varieties of malnutrition, due to many different causes, all of which, if they are severe enough or long-continued enough, lead to the one terminal result—*i.e.*, softness of bone. An infant may cut his teeth late, show laxity of ligaments (so-called double-jointedness), may sweat about the head, may have muscular weakness, and many other symptoms, all of which are commonly supposed to be manifestations of rickets, and yet show none of the changes in bone which are the criteria on which the diagnosis of rickets must rest.

The enormous diversity of the etiology of rickets is highly suggestive that there is no single factor in the causation, but many. We know, for instance, that heredity plays a not inconsiderable part in predisposing to the disease. We also know that almost every malhygienic factor in the environment of the child can play at times a recognisable part in its production. Of these food is the most important;

but climate, season, housing conditions, exercise and mothering cannot be disregarded as factors in the disease.

If all these indubitable factors, either singly or in combination, are admittedly the precursors of rickets, it surely seems irrational, to say the least, to hope that the disease can either be cured or prevented by any single expedient.

The causation must be as complex as the symptoms are heterogeneous, and the treatment must be as elastic and versatile as the causes are multifarious.

Before I proceed to discuss the reason why practically all forms of malnutrition which are common to infancy and childhood can lead, as their terminal result, to the true rickety condition—*i.e.*, soft bones, and all the consequences thereof—I propose to examine in greater detail the various factors in the environment which admittedly play a part in the etiology.

Food.

Errors of diet are at the present time considered to be the chief cause of rickets. Even breast-milk, if it does not come up to standard, or if the child is kept on it too long, is occasionally accused of causing rickets. Artificial feeding of infants is, to a large extent, confined

to civilised people, and these people are mainly to be found in the temperate climates. It is among civilised people that rickets is most common. One may almost say that rickets follows the belt of civilisation round the world.

Bad feeding is an undoubted cause, and the mistake may be with respect to quantity only. Even when the food is correct qualitatively, it may produce rickets if given in excess. Starvation practically never leads to rickets, so long as the food is otherwise of good quality.

If the food is grossly wrong as regards balance, there is a great accumulation of evidence that rickets may arise in consequence, the chief fault being an excess of carbo-hydrates, in the form of sugar or of insoluble starch. This excess is very common among artificially-fed children. One can produce rickets experimentally in a young animal by feeding it on an excess of starch or sugar. Similarly, if an animal is deprived of a sufficiency of fat rickets will result. Want of proteins can also produce rickets in animals.

There is no doubt but that the want of any one of those particular accessory food factors known as vitamines can produce malnutrition and consequently rickets. But these vitamines are not the only accessory food factors needed.

Others are also required, and these include salts in organic combination, especially calcium; lecithin bodies, cholesterol, and various extractives are also needed. In the absence of any of these accessory factors various forms of malnutrition will result and any of these may terminate in rickets.

Air and Exercise.

The child must have sufficient air or oxygen to breathe, or it will get into a condition of malnutrition owing to the curtailment of the oxidation processes and finally become rickety. Children may be deprived of air and oxygen in a variety of ways. They may be kept in too confined a space, or the respiratory passages may be blocked by adenoids and enlarged tonsils. Want of surface stimulation by fresh air is another predisposing cause. If the child is kept day and night or too long in the same set of clothes, this may also lead to rickets. Climate, too, may be a predisposing cause, there being a greater tendency to rickets in winter than in summer.

This seasonal factor may depend on confinement indoors, or, in the case of breast-fed babies, because the mother does not take as much fresh vegetable and fruit as in summer,

or, in the case of artificially-fed infants, because the cows are stall-fed. Unless the producer has enough fresh food, and especially green food, the milk may be deficient in certain vitamines.

Exercise is also a very important factor. It has been shown by Dr. Leonard Findlay, of Glasgow, that young animals become rickety if they are given no opportunity for exercise.

In Bohemia many of the country-bred people show marked symptoms of rickets. Nearly all are breast-fed, and have many other natural hygienic advantages, including plenty of out-door life. But, in spite of fresh air and good food, they develop rickets for the reason, I believe, that during the whole period of infancy they get no exercise, being swaddled and tied up in such a way that they can move neither arm nor leg.

Bad housing and bad mothering lead to great dangers connected with infections, and in this way tend to promote rickets, since practically all chronic infections of one kind or another, if of sufficient intensity, lead to malnutrition in infants.

I do not think it any exaggeration to say that the chief cause of infant mortality and ill-health is "infection." Mothering is good or bad according to the degree of protection against

infection it affords to the infant. Bad feeding and bad hygienic surroundings either expose the infant to unnecessary infection or lower the degree of resistance to bacterial invasion.

CAUSATION.

Is it possible to find a common pathological basis for soft bones developing in the child, which can reasonably be attributed to so many different etiological causes? I think so. I believe there is one common factor in all these conditions.

Soft bones are inevitably found in rickets. One always finds also that there is an excessive output of calcium from the body in the urine and fæces, and it therefore follows that there must be less calcium available for the growth of bones. Bone consists chiefly of cartilage which has been mineralised by calcium. If there is plenty of calcium the bone is hard. On examination of a rickety bone, it will be found that it contains little calcium, but excess of cartilage.

A reasonable explanation of rickets is that there exists some demand for calcium which is so great that the claims of bone for the time being cannot be satisfied; such a demand might exist if acid bodies were poured into the blood, for free acids cannot exist in the blood

without causing death. They must be immediately neutralised. Nature neutralises them with ammonium, sodium, potassium, or even calcium which she scrapes, as it were, from the very bones. The cause of rickets is that there is a greater demand for calcium in the blood than for calcium in the bones, great though the latter need may be. It must be clearly understood that in rickets calcium is not actually taken from the bones ; it is merely withheld from them during their early development and used for what is at the moment a more important object.

Under ordinary conditions food is taken into the system—

1. To supply energy.
2. To produce heat.
3. To build or repair.
4. To manufacture accessories, such as saliva.

If the supply of food is correctly adjusted to the above purposes all will be used up ; there will be no unconsumed fuel and the final end-products will be carbonic acid, water and urea. Carbonic acid is got rid of through the lungs, water through the kidneys and skin, urea or

ammonia in the urine. If you take more food than is needed large clinkers are left in the body from wasteful oxidation processes. Acids of all kinds, lactic, oxalic, proprionic, acetic, etc., are formed, and must be neutralised by ammonium, sodium, potassium, magnesium, etc., and possibly by iron and also by calcium. That is why so much calcium is found in the urine and fæces in rickety children. The stools of rickety babies contain an immense amount of calcium in combination with fatty acids in the form of soap, and in this way the system is depleted of this necessary base. The production in the body of an excess of acid elements which must be neutralised is, in my opinion, the *causa causans* of rickets.

Food is mostly wanted by the body as a source of energy for the performance of muscular work. If, therefore, a child does no work, does not sit up at a proper age, does not clutch, cling, move, etc., it creates no great demand for sources of energy, and the child is probably overfed ; in other words, a producer of acids.

If the child is not stimulated by cold it does not want to exercise its limbs, and it tends to become lethargic. An ill baby does not want to move, while everything that impairs the work-

ing capacity of the body leads similarly to a restriction of output, and consequently tends to render excessive an otherwise normal diet.

TREATMENT.

As regards the treatment of rickets, unless there is a deficiency of fat in the diet, no additional cod-liver oil or cream is needed, but the food should be reduced, and the child should be in the open air as much as possible, with full opportunity for exercise, and it will soon improve. The proportion of food given should be strictly in accordance with the amount of work done or exercise taken. If the child can hardly move, the food ought to be reduced to the lowest limits till he begins to improve in strength. The food must be well balanced, the proteids, fats, and carbohydrates must be in the best possible relationship, for instance, as in breast milk. The accessory food factors must be provided, there must be the fat-soluble vitamines and the anti-scorbutic vitamines. A sufficiency of organic salts must also be supplied. The child must be encouraged to take all the exercise he can, and, if necessary, massage must be employed to supplement the voluntary exercise.

The child must have plenty of air—open air,

if possible—and he must be stimulated by changes of temperature. A tepid douche of water is a great stimulant. A certain amount of cold applied to the body provides that encouragement to combustion that is so greatly needed. It is therefore advisable not to wrap a child up too much.

Drugs are unimportant factors in the treatment, though some may contribute to the cure. The drugs which are chiefly useful are salts which have an alkaline base, such as calcium, sodium, potassium, magnesium, etc. Cod-liver oil is indicated if the child has been starved as regards animal fats, while phosphorated cod-liver oil may also be given.

Should convulsions, indigestion, constipation, catarrhs or deformities arise in connection with rickets they need to be dealt with by appropriate means.

CHAPTER VIII.

THE EXAMINATION OF THE INFANT IN THE HOME.

I KNOW of few experiences which are better calculated to sharpen one's powers of observation than the examination of infants and young children, for the only reliable information you are, as a rule, likely to elicit about them is such as can be obtained by your own visual perceptions. In many respects we are in a better position to obtain an accurate idea with regard to the manner in which infants are being brought up by unexpectedly penetrating into their homes than we are, for instance, when we examine the same children under the strange conditions of a Welfare Centre. You will certainly be able to collect a certain amount of collateral evidence from an inspection both of the mother and of the home surroundings. If a woman is tidy and methodical in one direction she will almost certainly be tidy and methodical in others, and the converse is equally true. Your examination, therefore, will be very much assisted if you carefully scrutinize the mother and her surroundings as well as the

infant itself. I know, of course, that many of you have a very wide experience in these very matters, but those of you who have this advantage will, I know, forgive me if, for the benefit of those who have not, I include in my observations certain suggestions for a complete examination.

I propose therefore to divide the subject of the examination of the infant into three sections, namely (1) the examination of the mother; (2) the examination of the home; and (3) the examination of the infant.

As you are talking to the mother you will probably be able to draw a very fairly accurate estimate of her interpretation of what cleanliness, order, and tidiness mean, and if, without the display of any unnecessary curiosity, you can find out what her occupation has been before marriage you may possibly be able to draw certain additional inferences of value. For, as a rule, occupation has a great influence on character; servants, for instance, who have themselves been subjected to a certain amount of discipline, and who have associated with people of superior education, make as a rule, better mothers, than factory hands or girls who have served as millinery and dressmaking assistants, for the latter have

too high an appreciation of independence, Young mothers are generally much easier to deal with than those who have already had large families, and have gained what they consider to be experience. The greater the intelligence of the woman the more likely will she be to adopt reforms, if their advantages and expedience are carefully explained.

In a former chapter I enunciated to you certain principles involved in the making of character, and I expressed the opinion that *good manners depended more on the habit of obedience than on anything else.* Obedience is absolutely essential for the success of any educational method, and the infant is never too young to be taught how to obey. As I then pointed out, obedience must be insisted upon in reference to the hours of sleep, of waking, of feeding, and in respect of other functions which babies have to learn to perform properly. Many mothers seem to imagine that children should be coaxed and wheedled and cajoled into doing what is wanted of them, but there can be no greater mistake. This sort of misdirected kindness involves a vast deal of argument, nagging, and worrying, all of which are very disturbing factors in the making of character. From birth onwards infants should

learn to understand that the mother means what she says, and says what she means. Indecision is fatal to discipline, fatal for the formation of character, and there is nothing so transparent as forms of weakness of this kind; a baby can discover it in its mother before it is three months old, and you will be able to detect it in a few minutes' conversation; you can observe it in the way a woman deals with older children if she has them, or with her neighbours, or even with her pets. When you find a mother of this invertebrate type, you must in the first place impart a little artificial stiffness to the maternal backbone, if you wish the infant to do well. *If the child has to learn how to obey, the mother must know how to command.* There are naturally many other characteristics in the mother which are worth noticing from the point of view that they may have an indirect influence on the up-bringing of the child, and because they may explain virtues or short-comings which otherwise are not easy of explanation. Habits, both good and bad, are the fruits of education, and therefore, if you find a child wilfully disobedient, dirty, untidy, slovenly, or obstinate, and you wish to trace these results to their ultimate source, "*cherchez la femme*"—study the mother.

I do not wish you to think for one moment that there is nothing in heredity, and nothing in so-called family predisposition. Of course there is a very great deal, but traits of character or disposition do not display themselves quite spontaneously. They are always elicited by the application of the appropriate stimulus, aggravation, suggestion, or provocation. Although these traits or dispositions may have a potential existence in the undeveloped brain of the infant, nevertheless they have to be drawn out from their secret lurking places. *This is the true meaning of education. Education implies a drawing out or educing. To educate well is to draw out that which is good and useful, and to refrain from applying those particular forms of stimulation, or provocation, which draw out that which is bad.* It may be more difficult to draw out that which is good in certain cases than it is to draw out that which is bad, but nevertheless, with tact and intelligence it is always more or less possible to educate in any direction you please. I find, as a rule, that parents and instructors are very loth to admit that objectionable traits of character in children are due to anything else than to some form of malevolent providence. If it is suggested that bad management—bad education—may have some-

thing to do with the question one is generally met with the answer " that such is an impossible hypothesis, because, if it were so, all children in the same family would be of the same disposition." It must be remembered, however, that no two children, even in the same family, are made exactly alike; each has its own individuality or potentiality for becoming individual; some can be more easily trained than others, and *it is just this belief that education can be reduced to a cut and dried formula that produces such a large number of failures.* The child or infant has an individuality, and different educational methods have to be applied to different children to elicit the same response.

Turning from the examination of the mother to the examination of the home, let me indicate to you a few points which deserve attention. Apart from moral education, the chief factors in the environment of the child which determine the course of development, satisfactorily or otherwise, are the food it eats, the air it breathes, the sunshine it experiences, the clothing it wears, the hours it sleeps, the exercise it takes, and the bath in which it is washed. It is, therefore, to the manner in which the home surroundings comply with these hygienic requirements that your attention should be fixed.

Taking these points in the order enumerated above, you will first notice what provision is made for the feeding of the infant, and, in those cases in which artificial feeding is employed, you must carefully *observe what measures are taken for protecting the food or milk from contamination.* You will enquire the source of the milk supply, the times at which it is delivered, the method of boiling or scalding, and you will observe in what vessel, and in what position, the milk is kept. You will not infrequently find that it is kept in an open jug on the mantelpiece, or in some other warm and cosy corner. You must insist on its being kept in a clean jug, and, if possible, allowed to stand in a basin of cold water, either outside the window, or at least in the coolest available place. *You must see that the milk is boiled the moment it arrives, ana that, even after boiling, it is not kept too long before it is consumed. You must see, also, that it is protected from dust and the onslaught of flies.* The feeding bottle should next be examined, and, as you know, this should be of boat-shape, graduated in ounces or tablespoons, and the nipple should be of such a character that it can be turned inside out and properly cleaned. When not in use, the bottle and the teat should, after careful cleaning, be placed in

a basin of cold water, to which a little ordinary washing soda has been added. One basin may conveniently serve the double purpose of keeping the milk cool, and the bottle and nipple clean. *Always be on the look-out for a half-finished bottle which is being kept for a second feeding.*

On the subject of ventilation, I do not propose to say very much. I would, however, emphasize the great importance of the *open window*, the *economy of room space* by the avoidance of much furniture, the *avoidance of dust* by the use of the tea leaf, and the *habituation of the infant to cold air*. This last question I entered into in sufficient detail when I discussed the question of the education of the heat-regulating centres. Closely associated with the question of ventilation is the question of the sanitary arrangements. Soiled napkins are often allowed to remain about the room, or even to lie in the fireplace. Both of these are very dangerous practices. After use, soiled napkins should be thrown into a bucket of water containing a small quantity of washing soda, and subsequently they should be washed very thoroughly under the tap; flowing water is quite essential to their proper cleansing, and also for the removal of any possible remains of soda, which,

as you know, is liable to cause irritation, or even eczema, on the skin of the child. Sunshine and fresh air out of doors are certainly important hygienic factors, although it often surprises me to notice how comparatively well many slum children seem to be without the benefit of either one or the other. On the other hand, it is equally remarkable how many infants and children improve if one can only persuade the mother to take them out of doors regularly every day. It is far better to wrap up an infant warmly and place it at an open window, or to leave it on a balcony or convenient "leads," than to allow it to remain cooped up in the stuffy atmosphere of the ordinary London tenement. *From the point of view of catching a cold there is no more danger in the balcony or an open window than there is in a park or open space*, but this view never seems to strike the average mother.

The influence of sunshine on the vital activities, the stimulus of cold, fresh air to the respiratory functions, and to the processes of internal combustion, should be clearly kept before our minds, more particularly for the reason that both of these factors are concerned in the adequate training of the heat-regulating centres. From this point of view, also, the question of

clothing is a very important one. I have, indeed, already referred to the importance of keeping new-born infants thoroughly warm, but it is equally important not to overwhelm them with a superfluity of clothing, when once they have learned to accommodate themselves to a certain amount of cold. *Our object should be to train children to keep themselves warm by an active internal combustion;* at all costs children must be kept warm, but those that sleep warmly and comfortably with a single light flannel garment and one blanket for their protection, in a cool room with the window open, are of a very different standard of health from those who require hot-water bottles and a large number of blankets thrown over the bed. It is a difficult question to say to what extent you, as health visitors, are justified in interfering in matters which, perhaps, more properly come within the province of the medical adviser, but nevertheless I do not think it would be a very serious outrage if you surreptitiously felt the feet of the babies you are visiting, for by feeling an infant's feet you can probably derive nearly as much information as a medical man can by feeling the pulse. If the feet are cold, and more especially if they are habitually cold, the infant cannot possibly be in a good condition of health. *Cold*

feet imply a disorganised state of the nerve centres which control the circulation. These centres are technically called the vaso-motor centres. You need not, however, trouble yourself about the name, but, remember this, that if the blood is driven out of the legs and arms it must go somewhere else, and this often means an excess of blood or congestion of the internal organs, *e.g.*, of the liver, stomach, bowel, or brain. The unequal distribution of blood which is involved by cold feet carries with it all sorts of undesirable consequences which I need not enter into here, but the moral is—keep the feet warm at all costs. If the educational curriculum has been successful, the feet will remain warm without assistance ; if it has been inappropriate, or the child uneducable in this respect, it is necessary to see that the feet are kept warm by socks, or hot-water bottles, or any other means that effect the desired purpose. Cold feet are the result of bad early training. If a new-born infant's feet are ever allowed to get cold, they continue to remain cold by force of habit.

Now the whole question of infant clothing is so involved in difficulty that I hardly like to enter upon this subject. I have never been able to understand how our present customs

could have originated. Why, for instance, is it considered necessary to support the back by a stiff band of buckram? Why is it considered necessary to stitch on the flannel belt, and why should we do half-a-dozen other ridiculous operations which make the dressing of a baby a long and tedious business, and cause all sorts of unnecessary delays? Whatever form of clothing is adopted the following conditions should be complied with.

The clothes must be warm, light, loose, easily adjusted, and such as to give free play to the movements of the legs, arms, abdomen and chest. There seems to be a very general idea that the belly must be tightly bound round for fear of rupture or hernia; there are practically no grounds for such fears if the infant is properly managed. The causes of rupture for the most part may be summed up as follows:—(1) Over-distension of the stomach and bowels from excess of food, or from flatulence caused by indigestion; (2) from constant crying, owing to general mismanagement; (3) from coughing; (4) from weakness of the abdominal muscles, owing to want of use, to impaired nutrition, or to nervous incompetence. Tight binding up of the belly must tend to aggravate all these conditions, for any pressure displaces internal organs,

and interferes with their natural functions; it must therefore increase the internal tension, and by doing the work of the abdominal muscles it must interfere with their natural development. You need never fear that pot belly will develop in a healthy infant if it be properly fed, properly exercised, and properly managed generally. If the child is rickety, with flabby abdominal muscles, and suffers from indigestion, no binder will prevent the development of a large and distended abdomen, nor in certain cases a rupture.

On the subject of sleep, I have already had a good deal to say, but in your examination of the infant in its own home *you will have excellent opportunities of ascertaining what provision is made for securing adequate, comfortable and safe sleep*. The habit of allowing infants to sleep in the same bed as the parents is absolutely indefensible; suffocation from such a cause ought to be made a criminal offence. In the year 1901 there were 1,824 children under five years of age who died from suffocation, and the great majority of them from over-lying, or asphyxiation, when sleeping with their parents. During the recent war when liquor control was in full force, the number of deaths from over-lying was reduced by more than one-half, proving

that drunkenness plays an important part in this cause of infant mortality.

There ought never to be any difficulty in providing a suitable cot, for most excellent kinds can be improvised out of boxes or baskets; in my opinion, the most expensive cot ever made is no better for all practical purposes *than an ordinary Japanese basket which costs about* 2/-. The great virtues of Japanese baskets when used for this purpose are that they are light and easily moved about, they can be washed, and stand anywhere quite safely, on the table or on the floor; the sides are sufficiently pervious to currents of air to allow of excellent ventilation without draughts, and, perhaps best of all, *they do not lend themselves to rocking purposes.* When one considers that an infant spends, or ought to spend, the greater part of its life in its cot sleeping, it is very essential that this important element in its environment should be as good as possible. *Many cots in which infants are forced to sleep are constructed on the principle of a well,* with thick padded or quilted sides, through which there can be no ventilation —when this is the case, the heavy carbonic acid gas which is exhaled from the child's lungs can find no escape, and it collects round its head, just as gases collect at the bottom of a well.

The question of exercise is an immensely important one, from the point of view of the health and development of the infant. I think most mothers recognise in a general sort of a way that it is a good thing for an infant to kick and use its arms, but I want to impress upon you, and I hope you in your turn will impress the fact upon the mothers, that exercise is not only good for infants, but that it is absolutely impossible that they can be healthy without it. We depend on our muscles for almost everything we do; without muscular power we are paralytics. But this is the point that I wish you to thoroughly understand: *muscles do not grow or develop by themselves.* There seems to be a very widespread belief that muscles grow, and that strength develops *by feeding;* you cannot build up muscles or any other organ without material wherewithal to build them; food, therefore, is an essential necessity for their construction—*but you want something else besides food: you want work or exercise of function.*

Muscles only grow or develop if they are worked; that is why, if you break your leg, and it is put in a splint, all the muscles atrophy or waste away: they are prevented from working by the restraint imposed upon them; you may

feed them as much as you like, but they still continue to waste.

Let me give you another illustration. You know the way young girls were splinted up with buckram and whalebone not so very many years ago. Well, the consequence of this, or rather, one of the consequences of this, was that the muscles which ought to have supported the spine had their work done for them, consequently they did not develop, and that is why so many women at the present day suffer from backache or weak spines; the muscles are too feeble to do even the small amount of work that is required of them, and consequently they soon become fatigued, and make their owners conscious of their weakness.

The stimulus for the growth of muscles is any agent that calls them into activity; if you tickle an infant's foot it will withdraw it from the source of irritation or annoyance. Tickling is therefore a stimulus for the growth of muscle, not that I recommend this particular form of stimulus, but there are a hundred and one ways in which an infant can be encouraged or stimulated to make use of its muscles, and each one of them may be tried in turn.

Now it is one thing to say that an infant must have exercise, but quite another thing to say

how to give it. As in the training of all other organic functions, regularity and periodicity should be encouraged; the infant should be allowed to take its exercise more or less at the same time every day. I generally recommend an opportunity for exercise to be given just before giving a bottle, and just before, and possibly during, the bath; the child should be placed on its mother's lap before the fire, or in some other position where it can be kept warm and free from draughts; it should be disencumbered of its clothing and allowed to kick freely and clutch with its arms to any extent it seems disposed—you may even give it a little additional work to do by gently restraining voluntary movements by applying a little resistance with your hands; if the child pulls one way you can pull the other. During the bath the child may be encouraged to stretch itself, and even to attempt to stand. Some mothers seem to think this practice will lead to weak ankles, weak knees and bow legs. This is, however, the way to prevent them, as I shall mention presently. *The stimulus for the growth of bone is muscular exercise*, and the way to prevent weak ankles is to bring about development and tone of the muscles of the legs and feet.

All exercises should be carefully graduated,

and only spontaneous movements should be encouraged; for instance, if an infant tries to stand up in the bath, at first you should support most of the weight by holding it with both hands under the arm pits, or if the arms are strong, as they should be, by the arms, or wrists. No muscular movement of any kind should be prematurely forced out of its natural order of development, either during infancy or during early childhood; you must wait until the child evinces some natural or spontaneous inclination for any particular form of exercise.

You all know how much importance is attached to firmness in a baby. Now firmness is certainly a very important indication of health; in fact, no baby can be really healthy unless it is firm, but I want to explain to you that there is more than one kind of firmness. There is the firmness that is due to distension with fat or other unessential tissues, *and there is the firmness that is due to muscular tone*—this latter is the variety of firmness at which we should aim, and which alone is to be regarded as indicative of health and vigour.

Now tone in muscle is a very curious condition; it implies a sort of passive activity, if one may so use the expression. A muscle with tone is not absolutely at rest, it is doing a certain

amount of work which exactly counteracts the work of some antagonistic muscle, so that no actual movement of limb or body occurs ; all the work done under such conditions, although ultimately converted into heat, acts as a sort of stimulus to the activity of an antagonistic muscle, and in this way *tone acts as a constant stimulus to growth, and at the same time makes a useful contribution to the general store of bodily heat.* In fact, the muscles, as I think I have already mentioned, are the chief furnaces in the body. When muscles feel hard, firm and elastic, you may be quite sure that an active, healthy combustion is taking place in these vital furnaces. On the other hand, when they are soft and flabby it means that there is no passive activity, no constant stimulus to growth. *Exercise, tone, and development of muscle are therefore very closely associated; you can hardly have one without the others.*

Muscular activity and tone of muscle are very important from the point of view of the development of bone ; not only do the muscles, so to speak, pull the bones into shape, but they act as a direct and mechanical stimulus to bone growth. If you want to induce the growth of strong, straight legs, the muscles of the legs must be freely exercised ; their tone must be good.

Rickety children with bandy legs are children in whom the muscles are so weak and flabby that they have not afforded the necessary stimulus for growth of bones, nor the necessary traction to pull them into shape, nor the necessary support to prevent bending to one side or the other, if any weight is imposed on them.

The rickety or pigeon-shaped chest is equally due to the want of development of bone, owing, in its turn, largely to the want of stimulus afforded by tone and activity of muscle.

The fact that muscles will not develop except through exercise may explain a want of development of the heart, an organ which is itself nothing more nor less than a specially modified muscle. A normal healthy heart in an infant grows and develops in size and strength according to the amount of work given it to do. A long time ago it was observed that anæmic girls had relatively small and feeble hearts, and that at the same time they had small and narrow blood vessels. It seems obvious enough, when one thinks of the association between growth of muscle and exercise, to explain the smallness of the heart and blood vessels on the ground that such hearts and vessels have not had enough work to do ; but, in spite of this obvious connection, one of the greatest pathologists that

ever lived fell into the mistake of regarding the smallness of the heart and of the blood vessels in anæmia as due to some congenital or inborn cause, which had no association with any preventible condition in the environment. Although, looking at the matter in a completely open-minded way, one might be inclined to say that both the anæmia and the smallness of the heart were due to one and the same cause; one can say at least with the greatest confidence that you cannot make a large and strong heart without applying the necessary stimulus in the way of exercise, and that if you do so anæmia is very unlikely to develop.

Exercise has exactly the same influence in educating the respiratory organs as it has in training the heart itself. *All infants ought to put a little strain on the respiratory functions, every now and then,* by taking occasional deep breaths. This can be done both by exercise and by the cold douche; children ought equally to be made out of breath by running, or by some other form of active exercise; the education of both the heart and of the lungs is dependent on exercise. Finally, exercise is necessary for the education of the nerve centres which control muscular movements, for the promotion of the

circulation of fluids through the body, for the promotion of the peristalic or rhythmical movement of the bowel, and for stimulating the activity of the skin and other excretory organs.

The bath is a very essential element in infant education, both from the point of view of the training of the heat-regulating centres, and from that of general hygiene. It also has a soothing influence on the nervous system generally, and the friction exercised in drying with the towel stimulates the skin, and promotes the circulation of fluids throughout the body. It is desirable, therefore, that you should direct your enquiries with a view to discovering how the ablutionary duties are carried out. Two baths a day are certainly better than one, *the one in the morning may well be devoted to educational purposes, the one in the evening to ablutionary.* The educational bath should be conducted with due regard to the precautions to which I have already drawn attention : that is to say, during the first few weeks of life great care must be taken to avoid any possible chill or lowering of temperature, or any shock to the immature nerve centres. Later on, the tepid or cold douche may commence ; it should be given just before the infant is taken out of the bath ; at first the water should be warm or tepid, and by

degrees it may be allowed of a lower and lower temperature, until it is actually cold. It is, however, of great importance that the whole operation should be carried out quickly and with as little delay as possible. After a time, when the infant, or perhaps I should rather say the child, is quite used to the cold douche, it may be introduced to the tepid bath, and then to the cold bath, but the transition from the one to the other should be so gradual that the infant does not feel the change. The evening bath should always be a warm one, partly for more complete washing, and partly because the warm bath certainly soothes the nervous system and promotes sleep.

To dry the infant properly is certainly an art in itself. It is, as Dr. Howard Barrett says, "one of those simple difficult things" which mothers do so badly. At first, owing to the delicacy of the infant's integuments, the towel should be used very gently; later on, as they become hardened, a good deal more force may be expended on the friction; in fact, the vigorous drying which has such an excellent stimulative effect in older infants is only a modified form of massage. If you get an opportunity, it is just as well to examine the bath employed, for some mothers are rather fond of using an

ordinary basin : the wash-tub or foot-bath is far better adapted to the purpose of bathing infants —and a large quantity of water should, whenever possible, be employed.

I think I have now come to an end of all the important matters which are involved in the examination of the home, so I will at once pass on to the examination of the infant itself.

There is so much to say on this subject, that I propose only to select those points which appeal to me as being of great importance. Those of you who attend at the infant consultations will, I hope, have ample opportunity of seeing in practice how the examination of an infant may be conducted, and other points which are of minor importance you will find described in any of the books which are devoted to the subject of the management of children. It is a very curious fact that, although there are any number of people who think it worth while to study the points of a horse, a dog, or a cat, *there are comparatively few whose opinion with regard to the " points " of an infant is worth having.* An infant, owing to its more complicated and superior organisation, certainly has many more " points " than any lower animal.

And it is to these " points " that I more particularly wish to refer in the time that remains

at my disposal. Now, in the first place, let me remark that there are a number of " points " in an infant which depend, not so much on the manner in which it is brought up or reared, as upon causes over which we have no control whatsoever. These are hereditary and congenital " points." Most of the " points " which fall into this category, and to which I shall refer, must be regarded as distinctly bad ; for instance, hare-lip, cleft palate, webbed fingers, malformations of the heart, supernumerary fingers, and so on ; very often there is nothing directly disadvantageous in the presence of such abnormalities of development, but the mere fact that they have occurred at all implies, as a rule, that there has been, somewhere and somehow, a want of balance or equilibrium in the forces, nervous or otherwise, which control growth, and very often you will find more than one of these abnormalities present in the same individual. Malformations of this kind are generally described as " signs " or " stigmata " of degeneration, but there are also a very large number of physical defects which, though far less serious deformities than those enumerated above, are none the less to be regarded as stigmata of degeneration, or bad points. For instance, irregularities in the formation of the

palate or roof of the mouth, obliquity in the set of the eyes, deformities in the nose, irregularities in the contour of the ears, want of symmetry between the two sides of the face, birth marks of various descriptions, and a host of other minor defects, must all be regarded as bad points, for they imply, as I have already said, want of properly co-ordinated control of the process of development. From this point of view, abnormalities of actual growth must be regarded as distinctly more serious than mere abnormalities of function, though doubtless both are the same in kind though different in degree ; what I mean is this : actual malformation of the heart, for instance, is a more serious condition than erratic or irregular behaviour of a heart otherwise apparently quite normal in structure ; or hare-lip and cleft palate are more serious conditions than want of proper control over the act of sucking. The uneducatability, if I may use the word, of any nerve centre, no matter what function that centre may subserve, must be regarded in some degree or other as a " stigma " of degeneration, or as a bad " point." However, before one has any grounds for regarding failure in function as a definite sign of degeneration, one has to be quite sure that the failure is not

due to want of proper training rather than to actual incapacity to learn.

Now, bearing these principles in mind, let me direct your attention to certain points in the examination of the infant to which I have not already referred in my previous lectures. In the first place, let me say a few words on the subject of the condition of the skin, for the skin is really one of the first things about the baby to attract attention. Firstly, as regards the colour. The skin of the new-born infant is of a more or less uniform red colour; this is due to the fact that the fœtus has passed its existence in a water bath of a constant and relatively high temperature, and by relatively high, I mean high as compared to the temperature of its subsequent environment; in other words, the blood has not been driven from the surface by external cold. As soon as the infant learns to control its circulation, and the skin becomes more or less hard, the blood is driven from the surface, and retreats inwards.

By the change in colour of the skin you may note the educational advancement of the infant with regard to the management and distribution of his blood supply. The skin, then, should gradually fade from a somewhat light red to a more or less yellowish pink, and finally becomes

almost white, where the skin is protected by clothing, and to a more or less pink tone where it is exposed to the stimulus of the air. *Bright rosy cheeks*, which, according to popular tradition, are synonymous with health, *are indicative of want of proper nervous control over the superficial circulation.* It is exactly the same condition that we see in anæmic girls, it is often most becoming from an æsthetic point of view, but it cannot be regarded otherwise than as a distinctly bad point. It is quite true that all youthful cheeks should be capable of blushing, as they should be capable of becoming pale under the proper conditions, for alterations of this kind in the circulation imply a capacity for accommodation to changes in the surroundings; but what I mean is this—a permanently high colour in the cheeks means paralytic dilatation of the blood vessels in this situation, and is a sign of want of proper nervous control. Rosy cheeks very often imply that the infant is in a chronic condition of inability to cope with the forces which tend to raise its blood temperature, and these are usually over-feeding or over-clothing. In its efforts to reduce the temperature, the heat-regulating centre brings all the blood it can to the uncovered parts of the surface to positions in which it can be cooled by

the external air; on the other hand, paleness of the skin of the face generally means some failure of distribution, and blueness round the mouth, round the nose and eyes, and, indeed, of the hands and feet, also implies some breakdown in the control of the circulation. These conditions do not by any means imply, as is generally thought, some weakness of the heart; they mean, as a rule, some incompetency in the nerve centres which control the distribution of the blood, and are very often due to some powerful though misdirected stimulus reaching these centres from the stomach or intestines. Indigestion is a most fruitful source of disturbed circulation. The distribution of blood throughout the body is very greatly influenced by the emotions; fear, pleasure, shame, pain and excitements of all kinds have a very marked influence on the centres which control the circulation; the more impressionable, and the more badly trained these centres, the more influenced are they by the emotions, and various other stimuli which reach them through different channels. Bright rosy cheeks are, then, to be considered a distinctly "bad point" in an infant, especially when the dilatation of the capillaries or small blood vessels is so excessive that you can actually see the individual little lines or

streaks of red which mark the course of the blood channels. The complexion of a healthy baby is a uniform pink, unless under the stimulus of cold, or wind, or some powerful emotion such as pain or pleasurable excitement; under such conditions, moderate deviations from the normal tone are indications of capability to respond to changes in the environment.

The dryness or moisture of the skin is certainly a matter which deserves attention; a very dry, shrivelled condition is a bad sign: it is one of the most striking concomitants of atrophy, wasting or marasmus. I am not aware that any plausible explanations have ever been given for the lack of moisture; it is certainly not due to fever, for often there is a subnormal temperature. I am very much inclined to regard the obvious failure in nutrition of the skin, which accompanies atrophy, as merely one local manifestation of the general atrophy which pervades the whole system. On the other hand, excessive moisture or perspiration is an equally bad point. *A normal infant properly educated does not sweat unless the weather is really hot;* under such conditions sweating is a sign of health. It must be remembered, however, *that an infant has to learn to sweat;* at birth it is practically unable to do so, and, as a rule, it takes

six or seven days for the function of sweating to be established; temperature regulation and secretion of perspiration are so intimately associated, that you would naturally expect that, if an infant cannot control at birth the heat-regulating mechanism, it would not have much control over the function of sweating; and, as I have said, this is actually the case. I have little doubt that this inability to sweat on the part of new-born infants is one of the reasons why very hot weather is so fatal to them.

If you notice an excess of perspiration about the head or neck of an infant, you should ask yourselves what such a condition implies. Sweating, like other functions, occurs only in response to stimulation of some kind: it does not occur spontaneously, though it may very easily become a habit. The most obvious reason for an infant sweating is, that it is too hot, and an infant is, as a rule, too hot for one of the following causes: 1, because it is over-fed; 2, because it is over-clothed; 3, because some poison is circulating in its system, which upsets the heat-regulating centres and causes too active a combustion.

In examining an infant, it is as well to look at the nape of the neck to see whether there are indications of chronic sweating, that is to

say, whether the skin is red or macerated. The pillow should be examined also to see whether there are stains due to perspiration from the head. I have almost given up asking mothers whether their babies sweat or not, for they nearly always tell you that their babies do not sweat more than they should. They regard sweating in the same way that they regard regurgitating of milk after feeding, *i.e.*, as a normal act.

Redness under the napkin, round the buttocks, and over the upper part of the thighs, is due to a localized dilatation of the blood vessels in the parts concerned; this is due to excessive warmth, the result of the enormously voluminous diapers that are generally used; it is due also to internal irritation in the lower part of the bowel; it accompanies diarrhœa and acid fermentation. It is more often due to an excess of sugar in the food than to anything else. You will very often notice that when the buttocks are red the motions are quite frothy—this frothiness is due to the fermentation of sugar, and is very much the same sort of frothiness that you see when malt or sugar is fermented in a brewer's vat in the making of beer. Redness of the buttocks is certainly accentuated by want of cleanliness, and from neglect in changing soiled nap-

kins ; it is also sometimes intensified by the presence of excess of soda in the latter, but, from whatever cause arising, redness in this situation must be regarded as a distinctly bad point.

Pimples, spots, nettle-rash and eczema are all "bad points," although it is not always easy to discover the cause ; they are conditions which are brought about by abnormal stimulation of some kind, and they more often occur in those infants whose nerve centres are easily disturbed. For instance, I have more than once seen infants suddenly covered with nettle-rash owing to a shock or fall ; the irritation of the teething very often brings out a crop of spots ; indigestible food may do the same thing, and so may flannel or other material which irritates the skin. Eczema of the head is a very common complaint among babies. What the precise stimulus may be that causes this particular response, I do not know. I know this, however : that it more frequently occurs in the children of gouty parents, in cases in which the head is covered up too closely with thick and warm bonnets, and in those babies who are fed on excess of sugar. The way to cure it is to reduce the sugar, and to leave the head exposed to the wholesome influence of the pure air.

In examining the skin of an infant, *always*

carefully notice whether there are large blue veins running up the side of the head, for these are distinctly " bad points " ; they are generally to be discovered when there is much sweating, and are often present in rickety conditions ; *a blue vein running across the upper part of the bridge of the nose is also a bad point ;* it implies congestion of the back of the nose, throat, and possibly of the brain itself ; it is a very usual precursor of mouth-breathing and adenoids. I have already referred somewhat fully to the question of firmness in an infant ; the vast difference between firmness due to distension with fat, and firmness due to tone of muscle, should induce you, when you come to examine the infant, to try and find out to which cause the firmness is due. From this point of view, I cannot too strongly emphasize the value of the information you may obtain by lifting up an infant. *The infant of " muscular tone " seems to be as light as a feather ;* you nearly always under-estimate its weight, owing to the help it gives you. *A baby that is firm from fat and bad tissue, feels far heavier than it really is ;* it feels as floppy and flabby as a dead kitten, before " rigor mortis " has set in.

Elasticity and spring are infinitely more valuable points than firmness. You can estimate

these by lifting a baby up, and feeling the sort of resistance it offers to you when you catch hold of its arms or legs. The contour of the limbs also provides you with a great deal of valuable information. The contour should dimly indicate the outlines of the muscles beneath, and the bony prominences at the various joints; these outlines should not be obliterated by shapeless rolls of fat. The shape of the limbs and fingers, and to some degree also the shape of the feet and toes, deserve attention. The fat, short, podgy hand is a bad one, especially if it has pads of gelatinous material on the back, with deep dimpling at the knuckles. What is called the *trident-shaped* hand is a bad one—in this the fingers do not lie in any degree parallel to one another, they seem to radiate outwards. Each finger, fan-like, is more or less separated from its fellow at the extremities, and close in contact at the knuckles. I show you an illustration of the sort of hand I mean.

The shape of the head is also another important feature: in rickets it is square-looking and flat at the top, and the forehead looks bumpy or bossed; in certain conditions in which the pressure within the skull is excessive, as in water on the brain, the skull is ballooned out like a football. The size and condition of the fontanelle

are also points of importance. You will find full description of these matters in all books which deal with the subject of infants, but I think I have now given you sufficient data to enable you to discriminate between babies good and babies bad.

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